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DEBIPRASAD CHATTOPADHYAYA

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Volume 1

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Volume I

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Debiprasad Chattopadhyaya

INTRODUCTION

Surely it would be better to admit that men of the Asian cultures also helped to lay the foundations of mathematics and all the sciences in their medieval forms, and hence to set the stage for the decisive breakthrough which came about in the favourable social and economic milieu of the Renaissance. Surely it would be better to give more attention to the history and values of these non-European civilisations in actual fact no less exalted and inspiring than our own. Then let us give up that intellectual pride which boasts that 'we are the people, and wisdom was born with us'. Let us take pride enough in the historical fact that modern *science was born in Europe and only in Europe, but let us not claim thereby perpetual patent thereon. For what was born in the time of Galileo was a universal palladium, the salutary enlightenment of all men without distinction of race, colour, faith or homeland, wherein all can qualify and participate. Modern universal science, yes; Western science, no !*

Joseph Needham, *The Grand Titration.*

The present book is intended to be a part of the project on science in Indian history, on which we have been working. Before explaining the exact scope of the book specially as a preparation for the main project, it may be useful to have a few words on the relevance of the project itself. The main presuppositions of any such project, as explained by Professor Joseph Needham, are : "(1) that human social evolution has brought about a gradual increase in man's knowledge of Nature and control of the external world, (2) that this science is an ultimate value and with its applications forms today a unity into which the comparable contributions of different civilisations (not isolated from each other as incompatible and mutually incomprehensible organisms) all have flowed and flow as rivers to the sea, (3) that along with this progressive process human society is moving towards forms of ever greater unity, complexity and organisation."[1] Such presuppositions are, however, not acceptable to all, specially to those who are inclined to look at science as an essentially European phenome-

1. J. Needham, *Science and Civilisation in China*, Cambridge 1954—. Vol. 4 (1962) p. xxxi.

non. We may, therefore, begin with a brief examination of their position.

With the first foreshadowing of modern science in Europe in the sixteenth century, there also grew the tendency of working backward and trace the beginnings of scientific thought to the achievements of Mediterranean antiquity. This direct linking of modern science with the ancient Greek tradition is increasingly utilised by a flourishing literature in the cause of a rather simplified understanding of the history of global science.

The story, we are told, began with some kind of Greek "miracle" resulting in the dawn of science. Not that the facts of the older civilisations—of Egypt and Mesopotamia, and, in recent years, also of the Indus—are denied. But these are mentioned cursorily and mainly for the purpose of showing why there could be *no real* science before the Greeks. As Arnold Reymond[2] says, "Compared to the empirical and fragmentary knowledge which the peoples of the East had laboriously gathered together during long centuries, Greek science constitutes a veritable miracle."

After an exciting career of about seven hundred years in Greece, Alexandria and the Greco-Roman world, science is said to have suffered an eclipse, resulting in the darkness of the middle ages. The darkness prevailed over a thousand years. Then there was the illumination of Renaissance Europe, when the old Greek tradition was taken up again and conditions were created for the rise of modern science, with an ever-increasing rate of progress since then.

This, in brief, is supposed to be the history of science. What is true in it is, of course, often emphasised. What is fallacious about it is discussed only by a minority of conscientious scholars. The fallacy in short lies in the tacit equation of global science with science in European history. We have the

2. A. Reymond, *Science in Greco-Roman Antiquity*. Quoted by B. Farrington, *Greek Science*, Pelican 1963, p. 16.

scope here to discuss it mainly in so far as it has a bearing on the need of understanding the contributions of the Asian countries to the mainstream of science, which are usually ignored or at best desultorily mentioned.

That such an understanding of the history of science is not sufficiently scientific becomes obvious when we consider only one point. Even for the restricted purpose of understanding scientific developments in Europe, it is essential to take note of the contributions of the Asian countries. Let us see why.

To begin with, there is something apparently odd about the story as usually told. If the Greek tradition had so much to bequeath to modern science, how was it that among the Greeks and Romans themselves it suffered a creeping paralysis ? The question becomes all the more perplexing when we remember that the essential intellectual tools for the making of modern science were worked out by the Greeks long before Galen who died in A. D. 199. As Farrington[3] sums up : "Before the end of the third century B.C. Theophrastus, Strato, Herophilus and Erasistratus, Ctesibius and Archimedes had done their work. In the Lyceum and the Museum the prosecution of research had reached a high degree of efficiency. The capacity to organise knowledge logically was great. The range of positive information was impressive, the rate of its acquisition more impressive still. The theory of experiment had been grasped. Applications of science to various ingenius mechanisms were not lacking. It was not then only with Ptolemy and Galen that the ancients stood on the threshold of the modern world. By that late date they had already been loitering on the threshold for four hundred years. They had indeed demonstrated conclusively their inability to cross it."

Why, then, was this inability ? We shall quote Farrington again, who has answered the question in his masterly survey of *Greek Science* : "The failure was a social one and the remedy lay in public policies that were beyond the grasp of the age. The ancients rigorously organised the logical aspects of science,

3. B. Farrington, *Greek Science*, Pelican 1963, p. 302.

lifted them out of the body of technical activity in which they had grown or in which they should have found their application, and set them apart from the world of practice and above it. This mischievous separation of the logic from the practice of science was the result of the universal cleavage of society into freeman and slave. This was not good either for practice or for theory. As Francis Bacon put it, if you make a vestal virgin of science you must not expect her to bear fruit."[4]

When the muscles of the slaves were the only recognised source of power, science became increasingly irrelevant as a means of transforming the conditions of life. It became a relaxation and a pastime for a handful of social parasites. Cut off from the actual process of interrogating nature, the tools and implements for which were left exclusively to the slaves with no social status at all, science ceased to be a knowledge of nature and a power over it. Such was the blind alley into which science was pushed in the Greco-Roman world. Nothing short of a social revolution could rescue it. Between A.D. 400 and 800 the revolution took place, though as the work of the northern barbarians. "Even if in the end," says Engels, "we find almost the same main classes as in the beginning, still, the people who constituted these classes had changed. The ancient slavery had disappeared; gone were also the beggared poor freemen, who had despised work as slavish. Between the Roman *colonus* and the new serf there had been the free Frankish peasant. The 'useless reminiscences and vain strife' of doomed Romanism were dead and buried. The social classes of the ninth century had taken shape not in the bog of a declining civilisation, but in the travail of a new."[5]

It is not the place for us to go into the detail of the transition from slavery to feudalism, or, what is more important for the history of modern science, from feudalism to capitalism. But it is of material importance to note the slow operation of historical process that allowed the intellectual movements of the

4. *Ibid*, p. 303.
5. F. Engels, *The Origin of the Family, Private Property and the State,* Moscow 1952, pp. 253-54.

Middle Ages to bring modern science into being in the European cultural area. The most important clue to this is to be sought in the series of technological innovations witnessed by Europe roughly from the ninth century, which gradually transformed the economic basis of society. Quoting an inventory of these (from the IXth century harness of the saddle-horse down to the XVth century printing) prepared by Des Noettes, Farrington observes, "In another of his writings, a masterpiece of research and of historical analysis, Des Noettes discusses the social consequences of this series of inventions. He is not wrong when he insists that 'by fundamentally transforming the means of production they fundamentally transformed the social organism'. Nor is his conclusion lessened in importance when we understand that one of the transformations of the social organism involved was the disappearance of the last vestige of slavery and the possibility of undertaking immense constructional works with free labour—works of a kind which had normally been performed in antiquity by the forced labour of slaves. This implied an immense improvement in the consciousness of the modern world over the ancient."[6]

It was with this improved consciousness that Renaissance Europe looked back at Greek science and tried to understand its message, which was lost to the Greco-Roman world itself. "Graeco-Roman science was good seed, but it could not grow on the stony ground of ancient slave society. The technical revolution of the Middle Ages was necessary to prepare the soil of Western Europe to receive the seed and the technical device of printing was necessary to multiply and broadcast the seed before the ancient wisdom could raise a wholesome crop."[7]

We shall presently return to the question of these technological innovations. Before that, let us try to be clearer about the nature of the inheritance of Greek science by modern Europe. J. D. Bernal warns us against a naive understanding of it :

6. B. Farrington, *op. cit.*, pp. 306-7.
7. *Ibid*, pp. 307-8.

"It would be a mistake, natural enough in the time of the Renaissance but unpardonable now, to assume that all that happened then was the taking up again of classical culture where it left off, or even where it was at its best. What happened was something different and far more important. *The civilisations that took over the classical heritage of science had a hard task to prevent themselves from being stifled by it...* There was still, however, the vast store of knowledge to be found in books available to any with the desire or skill to read them. The Syrians and Arabs, and after them the medieval schoolmen and the humanists of the Renaissance, had to trace that store step by step back to its Greek originals...That they managed to absorb and transform it at all was by virtue of their own vigorous cultural developments. The very rediscovery of the works of the Ancients was the effect, far more than the cause, of the spurts of intellectual activity that characterised the beginning of Islamic science in the ninth century, of medieval science in the twelfth, and of Renaissance science in the fifteenth century.

"...Late classical culture was limited both socially and geographically. Socially it had become an almost exclusively upper-class preserve and was consequently abstract and literary, for ingrained intellectual snobbery had barred the learned from access to the enormous wealth of practical knowledge that was locked in the traditions of almost illiterate craftsmen. One of the greatest achievements of the new movement which culminated in the Renaissance was to raise the dignity of the crafts and to break down the barriers between them and the learned world.

"The geographical range of classical culture had largely been limited to the countries of the Mediterranean and the Near East. Its very completeness formed a barrier to the use of the common stock of techniques and ideas of the other ancient cultures of India and China. With the breakdown of the Roman Empire the way was open to much wider exchange and influence."[8]

8. J. D. Bernal, *Science in History,* Pelican 1965, pp. 266-7. Emphasis added. *Cf.* also p. 248.

We are now nearing the point we have been trying to make. The point is that even for the limited purpose of understanding the history of science in Western Europe, it is not enough to rely exclusively on information of European cultural area. The enormous importance of the contributions of Central and Western Asia to the first foreshadowing of modern science in Europe is now being increasingly realised, though a good deal of more research remains to be done on the subject. But let us leave that point for the present. Let us concentrate instead *only* on the technological innovations of the Middle Ages, without which, as we have just seen, the new enthusiasm for the Greek heritage of Renaissance Europe cannot be understood. How are we to understand these technological innovations ? Joseph Needham has boldly answered the question :

"In case after case it can be shown with overwhelming probability that the fundamental discoveries and inventions made in China were transmitted to Europe, for example, magnetic science, equatorial celestial coordinates and the equatorial mounting of observational astronomical instruments, quantitative cartography, the technology of cast iron, essential components of the reciprocrating steam-engine such as the double-acting principle and the standard interconversion of rotary and longitudinal motion, the mechanical clock, the boot stirrup and the efficient equine harnesses, to say nothing of gunpowder and all that followed thereform. These many diverse discoveries and inventions had earth-shaking effects in Europe, but in China the social order of bureaucratic feudalism was very little disturbed by them."[9]

The importance of the last point mentioned by Needham is surely not to be overlooked. It is connected, as he elsewhere says, with "what I believe is one of the greatest problems in the history of culture and civilisation—namely the great problem of why modern science and technology developed in Europe and not in Asia."[10] For the historian of science in

9. J. Needham, "Science and Society in East and West", in *The Science of Science*, Pelican 1966, p. 183.

10. J. Needham, *The Grand Titration*, London 1969, p. 154.

India there is no escape from the problem. One of the questions he is obliged to face is what inhibited the development of modern science in India, in spite of its brilliant early promise ?[11]

For the present, what we are trying to understand, however, is a different question. How are we to understand the emergence of modern science in Europe, or, more specifically, the technological stimulants required by it ? Here is how Needham sums up the results of his research : "The more you know about Chinese technology in the medieval period, the more you realise that, not only in the case of certain things very well-known, such as the invention of gunpowder, the invention of paper, printing, and the magnetic compass, but in many other cases, inventions and technological discoveries were made in China which changed the course of Western civilisation, and indeed that of the whole world."[12]

We may be yet far from a thorough and systematic exploration of the other important cultural areas of Asia—notably India and Central and Western Asia. But we have before us the stupendous volumes of Joseph Needham's *Science and Civilisation in China*, and we are expecting from him more volumes of the work.[13] Enough is contained in these to be considered as the most massive verdict on the facile claim that science is an essentially European phenomenon. One man has indeed exploded the myth nourished by generations.

It is mainly on the strength of the results reached in this great work that J.D. Bernal has come out with the following

11. J.D. Bernal mentions in this connection a possibility which is favoured by some contemporary Indian historians : "In the East, once the earlier stimulus to economic progress failed, the intellectual stimulus also vanished. Both might have revived later, but by the time they showed signs of this, as in India under the Moguls, their development was cut short by the superior commercial and military achievements of early European capitalism." *Science in History*, p. 284.
12. Needham, *The Grand Titration, ed. cit.*, p. 154.
13. "I have just turned 81, and although eleven volumes of the *SCC* series are already out, there are nine more to be finalised and issued before everything planned is completed": Joseph Needham, personal communication dated Dec. 13, 1981.

observation on the main point we have been trying to discuss : "The technical advances of the Middle Ages were made possible by the exploitation and development of inventions and discoveries which, taken together, were to give Europeans greater powers of controlling and ultimately of understanding the world than they could get from the classical heritage. Significantly, the major inventions...were not themselves developed in feudal Europe. All seem to have come from the East, and most of them ultimately from China...Already enough is known to show that the whole concept of the superiority of Western Christian civilisation is one based on an *arrogant ignorance of the rest of the world.*"[14]

"Arrogant ignorance" is an exasperated expression indeed. But it is hitting the nail on the head and hitting it hard. The old prejudice that science cannot but be an essentially European phenomenon sometimes goes to the extent of flouting obvious facts. Reviewing[15] the papers of a Symposium held in Delhi in November 1950 on *History of Sciences in South Asia*, Needham quotes Filliozat for a rather glaring example of this.

We quote Filliozat over again : "The greatest historians of science have not always escaped from the inconvenience of knowing only one side of the matter. Paul Tannery, so famous for his studies on ancient mathematics, is an example. We know that the trigonometric sine is not mentioned by Greek mathematicians and astronomers, that it was used in India from the Gupta period onwards (third century A. D.), that the *Sūrya-siddhānta* (fourth or fifth century A. D.) gives a table of sines, that the Arab astronomers knew them from their Indian contacts and passed them on to Europe in the twelfth century A. D., when the work of al-Battānī was translated into Latin. The only conclusion possible is that the use of sines was an Indian development and not a Greek one. But Tannery, persuaded that the Indians could not have made any mathematical inventions, preferred to assume that the sine was a Greek idea not adopted by Hipparchus, who gave only a table

14. J. D. Bernal, *op. cit.*, p. 311. Emphasis added.
15. J. Needham in *Nature*, Vol. 168, pp. 64 ff.

of chords. For Tannery, the fact that the Indians knew of sines was sufficient proof that they must have heard about them from the Greeks.

"If this is the way we are to argue, there was never any science other than the Greek science, and the question whether science has any origins other than the Greek 'miracle' is solved in advance. Only a profound study of Indian scientific developments in parallel with those which took place elsewhere about the same times can reveal the degree of originality of that science, and hence enable us to understand the role which India played in the history of the growth of man's knowledge of nature."[16]

It is not difficult to mention other examples. Amazed by the discussion of the preparation of alkalies in the *Suśruta-saṃhitā*, the eminent chemist and historian of chemistry M. Berthelot suggested that this portion of the *Suśruta* could only be a later interpolation inserted into the text after the Indians had contact with European chemists. He had no patience for some elementary chronological considerations which make such a claim palpably absurd and to which P. C. Ray draws our attention.[17]

More examples are perhaps not necessary. But this tendency to flout or ignore facts in defence of the idea of science being a monopoly of the Europeans cannot but lead to the suspicion of racialism, howsoever disguished and even unconscious it may be. In recent years it is passionately argued by some Asian scholars that the whole concept is used for inducing submissiveness among the Asians to the scientifically and technologically superior Western races, *i.e.* for colonial domination and colonial exploitation. "The political purpose behind this was to create a sense of inferiority amongst Asians and use science and technology as an instrument both of intellectual

16. J. Filliozat, *The Classical Doctrine of Indian Medicine*, Delhi 1964, pp. xix-xx. We have quoted the passage as translated by Needham.

17. See p. 360 of the present volume.

domination as well as exploitation."[18] Significantly, before Europe entered the career of colonial expansion, there was no such zeal to deny or undermine Indian contribution to the mainstream of science. Here is what a Spanish Muslim scholar wrote in A. D. 1068 : "Among the nations, during the course of centuries and throughout the passage of time, India was known as the mine of wisdom and the fountainhead of justice and good government and the Indians were credited with excellent intellects, exalted ideas, universal maxims, rare inventions and wonderful talents...They have studied arithmetic and geometry. They have also acquired copious and abundant knowledge of the movements of the stars, the secrets of the celestial sphere and all other kinds of mathematical sciences. Moreover, of all the peoples they are the most learned in the science of medicine and thoroughly informed about the properties of drugs, the nature of composite elements and peculiarities of the existing things."[19] If, in view of the complexities of Indian history we are being increasingly aware of, such an observation of about a thousand years back appears today to be rather naive, it is also refreshing if for no other reason than the complete absence of racialism—conscious or unconscious.

The view of science being a monopoly of Western Europe has other undesirable consequences. It serves the forces of conservatism within the Asian countries,[20] which, in defence of

18. A. Rahman, Introduction to *Science and Technology in Medieval India : A Bibliography of Source Material in Sanskrit, Arabic and Persian* (under publication). I have also before me the manuscript of A. Rahman's *Intellectual Colonisation : Science and Technology in East West Relations*, where the same point is more vigorously argued.
19. Abu'l-Qāsim Sā'id bin 'Abdur-Raḥmān bin Muḥammad bin Sā'id al-Andalusī's comments on India in *Tabaqāt al-Umam (Categories of Nations)*, A.D. 1068/460 A.H. Quoted by M. Saber Khan, "India in Hispano-Arabic Literature : An Eleventh Century Hispano-Arabic Source for Ancient Indian Sciences and Culture", in *Studies in the Foreign Relations of India* (Professor H. K. Sherwani Felicitation Volume), Hyderabad 1975, p. 359.
20. See S. Nurul Hasan, Introduction to *Ibn Sina : His Life and Contributions* by S. M. Ibrahim, New Delhi 1981.

stagnation and *status quo*, prefer to cut off Asian culture from the mainstream of global science. This makes it convenient to project the irrational religious-mystical trends of the past as representing the quintessence of Asian culture. In India at any rate we are painfully aware of where this leads to. In its cruder form, it debauches people's minds by accustoming them to ignore science in favour of obscurantism, which is required for caste hatred and communalism sanctifying malevolence and murder. In its sophisticated form, it inflates our ego and wants us to be convinced that, compared to the inferior ideal of science and rationalism, Indian sages discovered the secret of some mysterious supra-scientific knowledge. S. Radhakrishnan, for example, goes to the extent of regretting the modern fascination for science and rationalism : "The Western mind lays great stress on science, logic and humanism. Hindu thinkers as a class hold with great conviction that we possess a power more interior than intellect by which we become aware of the real in its intimate individuality...Intuitive realisation is the means to salvation...'He who knows that supreme *brahman* becomes that *brahman* itself'...While the dominant feature of Eastern thought is its insistence on creative intuition, the Western systems are generally characterised by a greater adherence to critical intelligence...From the Socratic insistence on the concept to Russell's mathematical logic, the history of Western thought has been a supreme illustration of the primacy of the logical. Rationalism is deep in our bones, and we feel secure about scientific knowledge and sceptical about religious faith."[21] Perhaps the only point of any historical significance about this breath-taking generalisation is that only one among the many philosophical trends in India, namely Vedānta, was keen on denying logic and rationalism in order to make room for an abject faith in the scriptures, declaring the scriptures as the repositories of direct spiritual realisation, and all this as sharply contrasted with other

21. S. Radhakrishnan, *An Idealist View of Life* (Hibbert Lectures 1929), London 1937, pp. 127-33.

philosophical trends strongly defending logic and rationalism.[22] That the philosophical trend glorified by Radhakrishnan received strong support of the Indian law-makers is a pointer not only to its immense prestige among the Indian elites but also to its social function, for obviously enough the law makers would not boost a philosophy that did not serve their main purpose and the main purpose of the law-makers was the defence of the caste-structure of society.[23] Nevertheless, because of the inflated importance attached to this philosophical trend by scholars like Radhakrishnan and others, considerable confusion is created even among our working scientists, some of whom—with admirable scientific skill in their professional life—are inclined to nourish obscurantist views as their private convictions, perhaps under the delusion that this is the way of seeking sanction of the national heritage. Hence are the well-known cases of "split personality" of our scientists.[24] This, to say the least, is undesirable and self-defeating. However patriotic it may seem, it does create an impediment in the way of the formation of the scientific attitude, without which the present socio-economic set-up can never be radically changed.

But the generalised claim that Indian culture is essentially spiritual is as much a myth as the one with which it is in open collusion, namely that science is something essentially European. We have to scrap both and the right way of doing it is to work for the reconstruction of the origin and development of science and scientific thought in Indian history, as Needham has done in the case of Chinese history. This does not surely mean that we are equipped today to achieve comparable results. What it means is that the work must have priority while we think of the areas of our research. It is important not only for a better

22. D. Chattopadhyaya, *What is Living and What is Dead in Indian Philosophy*, New Delhi 1976, ch. I.
23. *Ibid.* ch. 5.
24. D. Chattopadhyaya, "In Defence of the Marxist Impact" in *Impact of Marxism in Indian Life and Literature*, Mysore 1972, pp. 37ff.

understanding of our own cultural heritage but also for correcting the prevailing imbalance in the story of global science. And the work itself, as Needham observed, "remains enthralling."[25]

The work is not easily done. It is necessary for the purpose to seek answers to a considerable number of questions. What did India contribute to the general fund of science and scientific thought specially in the ancient and medieval periods ? What were the special areas of these contributions and how are we to account for the importance attached to these ? How in different ages did science respond—or was prevented from responding—to the technological experience and the store of empirical knowledge locked up in the craft-lores ? How was the literary tradition in science related to the folk tradition, which, as is evident, for example, in the case of medicine, has always been very strong in India ? What was the nature of interaction between science and other dimensions of Indian culture, like religion, philosophy and jurisprudence ? What was the nature of scientific exchange of India with other countries—with China and Tibet, with Central and Western Asia, with Greece and Rome, and in the still earlier period with Egypt and Mesopotamia ? What role did foreign trade and commerce play in this interchange ? Above all, how was science related to society in the different stages of Indian history ? How far, in this relation, we are to seek clues to the periods of outbursts in scientific activities alternating with periods of stagnation and decay ? Lastly, what were the inhibiting factors that prevented the rise of modern science in India in spite of its early promise and prolonged continuity ?[26]

25. J. Needham in *Nature*, Vol. 168. pp. 64ff.

26. Continuation of the tradition of astronomy specially among the scientists of Kerala may be mentioned here as an example. K. V. Sarma of Hoshiarpur, to whom we are indebted for a good deal of work on the subject, writes (in a personal communication dated 6.1.82 to my friend and collaborator Sri Ramkrishna Bhattacharya) : "To be sure, there has been steady and rather reverential 'continuity' in astronomical science [after Bhāskara II] but streaks of 'progress' through a rationalistic questioning mind had been there, as evidenced by works like *Rāśi-gola-sphuṭa-nīti* of Mādhava of the 14th century, *Jyotirmīmāṃsā*

Evidently enough, it is desirable to have a team of historians, scientists, philologists, philosophers and specialists in other branches to tackle such a wide range of questions. There is today some talk in the country of forming such a team. In the meanwhile, something remains to be done. We have to consolidate the results already reached by the earlier generations of scholars. This brings us to the main scope of the present book.

It is true that compared to the tons of books written on Indian metaphysics, religion and mysticism, there has been a sad neglect of what B. N. Seal[27] called "the work of constructing scientific concepts and methods in the investigation of physical phenomena". But this does not mean that we have to start today from mere scratch. Though in a minority, some of the scholars—both Eastern and Western—went against the stream and took an absorbing interest in the scientific activities in India. The tradition they respresent is not to be slighted. They include the early visiting scientists like I-Tsing (whose medical background is sometimes overshadowed by his image of being a Buddhist monk) and al-Bīrūnī, whose vision of science as an international endeavour led him not only to make Indian works on astronomy available in Arabic translation but also to make Greek works on science available to the Indians translated into Indian language, *i.e.* Sanskrit.[28]

of Nīlakaṇṭha (born 1444) and *Gaṇitayuktayaḥ*, being short rationales of mathematics and astronomy by several astronomers of Kerala. But, even I am at a loss to visualise realistically how they made this progress. The possible explanation could be the nature of Indian tradition of throwing away, *i.e.*, not keeping, the record of the intermediate steps and arguments of derivation, once the resultant formulae have been reached—a tradition in distinct contrast of the Western tradition from early periods."

27. B. N. Seal, *Positive Sciences of the Ancient Hindus*, reprint Delhi 1958, p.iv.
28. In the Introduction to *Ghuraat al-Zigat or Karaṇa Tilaka* (A Handbook of Astronomy by Bijayanand [sic] of Benaras), Translated from Original into Arabic...by...al-Bīrūnī [prepared for publication by N. A. Baloch], Sind (Pakistan), Institute of Sindhology, 1973, are mentioned the following books translated into Sanskrit by al-Bīrūnī :

They include some of the profoundest scholars of the eighteenth, nineteenth and twentieth centuries doing a great deal of pioneering work—searching for the manuscripts, settling their reading, interpreting their science potentials and trying to solve the most difficult chronological questions. The contemporary historian of science in India cannot but depend on their work. But their contributions remain buried often in the brittle pages of rare journals, often in books gone long out of print, and thus becoming increasingly inaccessible to us. An attempt is made in this book to recover and present some of these with the awareness of the requirements of our contemporary historians, scientists and philosophers.

It remains for us to add only one point. The purpose of the present book is not to be misunderstood. Admirable though the contributions of the pioneers are, indispensable though these may be for the contemporary historians of science in India, the presentation of these in the form of a convenient handbook can in no way be claimed as an adequate account of science in Indian history. As is perhaps evident from some of the questions just mentioned, science in Indian history is an enormously complicated subject and is surely not to be confused with some kind of a catalogue of the prominent achievements of Indian scientists. We have, for example, in the present collection, the model of such a catalogue as prepared by Th. Stcherbatsky in 1923. In spite of perhaps what is inevitable, namely that some of his observations are in need of correction

a) *Elements* of Euclid (No. 30)
b) *Almagest* of Ptolemy (No. 31)
c) Book on Astrobale by al-Bīrūnī (No. 32)
d) Key to the Science of Astronomy by al-Bīrūnī (No. 8).

It seems however that these translations were not preserved, because from the *Rekhāgaṇitam* of Jagannātha we learn that under the direction of Jayasiṃha II (of Jaipur, ruled A.D. 1699-1743) Ptolemy's *Almagest* (*Majisti*) and the *Elements* of Euclid (from the Arabic versions of al-Ṭusī) were translated again into Sanskrit : see S. N. Sen, *A Bibliography of Sanskrit Works on Astronomy and Mathematics*, New Delhi 1966, pp 89-90. Incidentally, as a reminder to the norm of internationalism in science, it may be mentioned here that Jagannātha's *Siddhāntasamrāj* repeatedly refers to the work of Ulugh Beg of Samarkand.

in the light of later researches, the usefulness of such a catalogue when it was prepared is not to be undermined. It was then some kind of a novelty and it was in response to a necessity then keenly felt. We can judge this from what Stcherbatsky said only a few years before (1916). "The Indian thought on the whole still remained enveloped in the mist of oriental fantasy and the orderly forms of its consistent logical theories were hidden from the keen sight of the historians of philosophy owing first to the inadequacy of the material available to them and second to the lack of any systematic methods for its scientific study. Besides this stage of scientific knowledge, there could be discerned, in the wider circles of reading public, a morbid interest in Indian philosophy caused by the hazy state of our knowledge of the subject and the various fables of supernatural powers rampant therein."[29] It was in such a situation that Stcherbatsky wanted his readers to meet the logicians and the atomists, the astronomers and the mathematicians, the physicians and the chemists, the technicians and the engineers of ancient India. A mere list of them and of some of their achievements could be and were indeed of much significance for the earlier stage of historical research, though the fact is that many earlier conclusions have been rejected and corrected.

We have no doubt outgrown this stage. This is not merely because the different areas of scientific activities in India are more intensively explored and still being explored, though only by a minority of scholars. It is more particularly because of the profound change in the scientific historiography of science that has in the meanwhile taken place. But basically the same model of catalogue-making without any reference to the social and economic factors sometimes persists, as is evidenced by Binoy Kumar Sarkar's *Hindu Achievements in Exact Sciences* (1918) and the much more enlarged version of practically the same model in *A Brief History of Science in India* (1971) edited by D. M. Bose, S. N. Sen and B. V. Subbarayappa.

29. Th. Stcherbatsky, Introduction to the Russian translation of Dharmakīrti's *Santānāntara-siddhi.* Petrograd 1916. See *Papers of Stcherbatsky,* Calcutta 1969, p. 73.

Its other limitations apart, the model of catalogue-making remains exposed to a number of risks. The most serious of these seems to be that it may encourage the tendency to look at science as some kind of an autonomous discipline without being basically influenced by society. That is not helpful for understanding science either in Europe or in Asia. Let us end by quoting Joseph Needham. The present book being basically an anthology, the following long extract from his writing may as well be cosidered his contribution to the scientific historiography of science :

"In recent decades much interest has been aroused in the history of science and technology in the great non-European civilisations, specially China and India, interest, that is, on the part of scientists, engineers, philosophers, and Orientalists, but not, on the whole, among historians. Why, one may ask, has the history of Chinese and Indian science been unpopular among them ? Lack of the necessary linguistic and cultural tools for approaching the original sources has naturally been an inhibition, and of course if one is primarily attracted by +18th and +19th century science European developments will monopolise one's interest. But I believe there is a deeper reason.

"The study of great civilisations in which *modern* science and technology did not spontaneously develop obviously tends to raise the causal problem of how modern science did come into being at the European end of the Old World, and it does so in acute form. Indeed, the more brilliant the achievements of the ancient and medieval Asian civilisations turn out to have been the more discomforting the problem becomes. During the past thirty years historians of science in Western countries have tended to reject the sociological theories of the origin of modern science which had a considerable innings earlier in this century. The forms in which such hypotheses had then been presented were doubtless relatively crude, but that was surely no reason why they should not have been refined. Perhaps also the hypotheses themselves were felt to be too unsettling for a period during which the history of science was establishing

itself as a factual academic discipline. Most historians have been prepared to see science having an influence on society, but not to admit that society influenced science, and they have liked to think of the progress of science solely in terms of the internal or autonomous filiation of ideas, theories, mental or mathematical techniques, and practical discoveries, handed on like torches from one great man to another. They have been essentially 'internalists' or 'autonomists'. In other words, 'there was a man sent from God, whose name was...' Kepler.

"The study of other civilisations therefore places traditional historical thought in a serious intellectual difficulty. For the most obvious and necessary kind of explanation which it demands is one which would demonstrate the fundamental differences in social and economic structure and mutability between Europe on the one hand and the great Asian civilisations on the other, differences which would account not only for the development of modern science in Europe alone, but also of capitalism in Europe alone, together with its typical accompaniments of protestantism, nationalism, etc., not paralleled in any other part of the globe. Such explanations are, I believe, capable of much refinement. They must in no way neglect the importance of a multitude of factors in the realm of ideas—language and logic, religion and philosophy, theology, music, humanitarianism, attitudes to time and change—but they will be most deeply concerned with the analysis of the society in question, its patterns, its urges, its needs, its transformations. On the internalist or autonomist view such explanations are unwelcome. Those who hold it therefore instinctively dislike the study of the other great civilisations.

"But if you reject the validity or even the relevance of sociological accounts of the 'scientific revolution' of the late Renaissance, which brought modern science into being, if you renounce them as too revolutionary for that revolution, and if at the same time you wish to explain why Europeans were able to do what Chinese and Indians were not, then you are driven back upon an inescapable dilemma. One of its horns is called

pure chance, the other is racialism however disguised. To attribute the origin of modern science entirely to chance is to declare the bankruptcy of history as a form of enlightenment of the human mind. To dwell upon geography and harp upon climate as chance factors will not save the situation, for it brings you straight into the question of city-states, maritime commerce, agriculture and the like, concrete factors with which autonomism declines to have anything to do. The 'Greek miracle', like the scientific revolution itself, is then doomed to remain miraculous. But what is the alternative to chance? Only the doctrine that one particular group of peoples, in this case the European 'race', possessed some intrinsic superiority to all other groups of peoples. Against the scientific study of human races, physical anthropology, comparative haematology, and the like, there can of course be no objection, but the doctrine of European superiority is racialism in the political sense and has nothing in common with science. For the European autonomist, I fear, 'we are the people, and wisdom was born with us'. However, since racialism (at least in its explicit forms) is neither intellectually respectable nor internationally acceptable, the autonomists are in a quandary which may be expected to become more obvious as time goes on. I confidently anticipate therefore a great revival of interest in the relations of science and society during the crucial European centuries, as well as a study ever more intense of the social structures of all the civilisations, and the delineation of how they differed in glory, one from another.

"In sum, I believe that the analysable differences in social and economic pattern between China and Western Europe will in the end illuminate, as far as anything can ever throw light on it, both the earlier predominance of Chinese science and technology and also the later rise of modern science in Europe alone."[30]

30. J. Needham in *The Science of Science*, Pelican 1966, pp. 184-87.

SOURCES AND PRINCIPLES OF REPRINT

Excepting for typographical and other allied changes and excepting also for occasional shortening of some of the studies mainly for the purpose of avoiding repetitions, the present reprints are intended to be verbatim. Though the earlier practice was to use Devanāgarī script for the Sanskrit quotations, in the present reprint these are uniformly transliterated into Roman script according to the internationally accepted principles. The attempt to avoid repetitions necessitated considerable shortening of some of the studies. In a few cases, specially where the original study does not have a suitable title, liberty has been taken to suggest one.

Evidently enough, there exist a number of significant studies in the same subject and the selection of only one among these is liable to be more or less arbitrary. Still, an attempt is made to select specially those that are likely to be most convenient for the researchers today.

We give below a full list of the sources from which the studies for the present volume are taken, with grateful acknowledgement to the original publishers :

1. Th. Stcherbatsky, "Scientific Achievements of Ancient India". Report on the work of the Russian Academy of Sciences for the year 1923, compiled by S. F. Ol'denberg and read at the meeting of the Academy held on February 2, 1924. Leningrad 1924, pp. 1-25. First English translation published in *Indian Studies : Past & Present*, Vol. x No. 4, pp. 315-31.

2. H. Jacobi, "Atomic Theory in Indian Thought". *Encyclopaedia of Religion and Ethics*, ed. J. Hastings, T. T. Clark, Edinburgh 1908. Vol. ii, pp. 199-202.

3. B. N. Seal, "On the Scientific Method". *The Positive Sciences of the Ancient Hindus*, Longmans Green, London 1915, pp. 244-91 (shortened). First published as an Appendix to Dr. P. C. Ray's *A History of Hindu Chemistry*, Vol. ii, 1909.

4. T. W. Rhys Davids, "Causality as Weltanschauung", *Dialogues of the Buddha*, Henry Frowde, London 1910, part ii, pp. 42-49, published as the Introduction to the *Mahānidāna-suttanta.*

5. G. N. Mukhopadhyaya, "On the Medical Authorities". *History of Indian Medicine*, 3 vols, Calcutta University 1923 (considerably shortened).

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7. — , "Composition of the Caraka-saṃhitā in the Light of the Bower Manuscript". *Journal of the Royal Asiatic Society,* 1909, pp. 857-93.

8. J. Jolly, "Physicians and Therapy". *Indian Medicine,* translated from German with notes by C. G. Kashikar, Poona 1951.

9. D. Chattopadhyaya, "Case for a Critical Analysis of the Caraka-saṃhitā". Paper presented at the IVth World Sanskrit Conference, Weimar, GDR, May 23-30, 1979.

10. I-Tsing, "Observations on Medicine in India and China". *A Record of the Buddhist Religion as practised in India and the Malay Archipelago* (A. D. 671-95), translated by J. Takakusu. The Clarendon Press, Oxford 1896, pp. 126-140.

11. J. Jolly, "Indian Medicine in its External Relations". *op. cit.*

12. A. Csoma de Koros, "Analysis of a Tibetan Medical Work". *Journal of the Asiatic Society of Bengal*, 1835, pp. 1-20.

13. P. O. Bodding, "Santal Medicine". *Studies in Santal Medicine and Connected Folklore*, *Memoirs* of the Asiatic Society of Bengal, Vol. x, part 1, 1925, pp. 137-57.

14. Al-Bīrūnī, "On Alchemy in India". *Alberuni's India*, translated by E. C. Sachau. Kegan Paul, London 1910. Part i, Ch xvii, pp. 187-95.

15. J. Filliozat, "Al-Bīrūnī and Indian Alchemy". *Al-Bīrūnī Commemoration Volume*, Iran Society, Calcutta 1951, pp. 101-5. (translated from French).

16. P. C. Ray, "Chemistry in Ancient India" and "Antiquity of Hindu Chemistry". *Essays and Discourses by Dr. Prafulla Chandra Ray*, G. A. Natesan, Madras 1918, pp. 73-102.

17. G. P. Majumder, "The History of Botany and Allied Sciences", UNESCO, Paris 1951.

PHILOSOPHY & SCIENCE

SCIENTIFIC ACHIEVEMENTS OF ANCIENT INDIA

Th. STCHERBATSKY

INTRODUCTION

The progress of a nation, viewed in historical perspective, does not always proceed along a continuously advancing straight line. At times this progress is arrested, and the reverse process sets in. Though this phase may be more or less temporary, it may sometimes lead to even complete annihilation of the native population from the arena of history and its replacement by the aliens. The historical development of the peoples is checked by wars—external and especially internal—particularly when they continue too long. But, then, they also do some good provided they are followed by spells of peace and order—sometimes on a larger territory than that involved in war. The history of the Indian peoples, as that of no other peoples on earth, for four thousand years of which more or less accurate data are available, is full of such examples of zigzag advance and arrest of culture. We see clearly that during these four thousand years of India's history, in the few epochs when the country was united under one power, was well governed, and was not subject to foreign yoke, it made rapid advances in all directions. The remarkably rich and large territory of the country and the high degree of competence of the people apparently secured the possibility of its rapid progress. And in fact, when in the fourth century B.C., in the course of its aggressive advance on the East, the Greek civilization reached India, it met resistance from the high Brahmin culture which was in no way inferior to the Greek civilization. Alexander's forces were found inadequate for conquering even a small part of Indian territory. The towns founded and the population left behind by him were fast submerged in the surrounding Indian environment, exerting little or almost no influence.

There are, on the whole, two distinct periods in the history of India when large territory of the country was united under

one power, was well governed, and was strong enough not only to repel any foreign attack but also to march on the path of progress. The first of these is that immediately following Alexander's invasion; the other—and a more prolonged one—is that from the fourth to the seventh century A.D. During all other periods, India appears to us a picture of disorder, internal discord and weakness as compared to her neighbours, who flowed into her territory in a continuous stream and dominated the country one after another. The Persians, the Greeks, the Scythians, the Turks, the Huns, the Arabs, the Afghans, the Mongols, and then the Portuguese, the Dutch, the French and lastly the British—all avidly strove for the domination of the country, whose legendary riches, high culture and unusual weakness held out promises of rich gain—until the British finally overpowered all the rivals and united the whole country under their sway. ...As also in other countries, nothing in India could withstand the energy of Islam. What happened in many other countries did not, however, happen in India. The Indian culture did not vanish once and for all. What happened in India was something unusual and almost singular in the history of humanity: the national life withdrew within its ancient heritage and preserved itself within the socalled caste structure and in particular alliances of religious character imbued with the spirit of extreme conservatism, culturally absolutely static, inaccessible to any outside influence, and at the same time highly submissive to any power, resigned to any foreign aggression—not having the capacity to show any resistance whatsoever. Under this strict caste system, no progress could have been possible.

CHARACTER OF THE PEOPLE

The scientific achievements of the Indians are closely related to their national character, which has left its imprint on all their work. What strikes most a student of the history of Indian scholarship is the excessive development of the imaginative powers of the Indians. In any work, some imagination is absolutely essential. Not to speak of poetry and philosophy, no

hypothesis is possible without imagination. Its exceptional or prominent development, however, becomes a setback : it alienates a person from reality, that is from truth and may lead him so far away that the gulf between fantasy and reality may become unbridgeable. It would be unfair to say that the flight of fantasy in India was absolutely unchecked. Normally, proceeding from a rational basis and developing with inexorable logic, this fantasy works in a known direction along specific lines ; the idea is worked out upto the end till it leads either to a blind alley or to absurdity. The remark made by the leading modern mathematician-philosopher, Bertrand Russell, that one wishing to be a philosopher must learn not to be scared of absurdity, is fully applicable to the Indian methods of work. The Indians never feared carrying things to absurdity if their inexorable logic so demanded. Such disposition of the people, it is clear, made them take up primarily those sciences which were dominated by the method of speculation—the method *a priori*—viz. inference of a result theoretically from some principles established or accepted beforehand on belief. This is why philosophy has been the strongest side of Indian scholarship. This field is still far from being fully known to us. One might even say that the veil has hardly been lifted from the enormous riches of Indian philosophical thought. And nevertheless, we have witnessed what revelation the first light of Indian thought has brought to Europe in spite of its having reached through the prism of bad translations. Schopenhauer's system, as its author himself acknowledged, was much indebted to Indian influence. But the pioneer work in this field is still only in its infancy. The greatest Indian thinkers, Dignāga and Dharmakīrti, are almost still unknown to Europe.

As regards experimental sciences, one cannot say that the Indians did not at all know experiment and observation. On the contrary, they were very good observers. We have highly significant embryos of a majority of experimental sciences during the glorious period of Indian scholarship. However, in this respect, they lag behind other nations, particularly the Greeks. During the period of decadence and difficult living conditions,

the experimental sciences completely vanished whereas the favourite contemplation of Indians went on.

PHYSICS

Indian physics represents the transition state from pure philosophical speculation to experimental science. We have a number of theories about the structure and evolution of the material world from the primary substance. From the most ancient times, we find in India a number of cosmogonic systems, gradually passing over from mythological conceptions to distinctive scientific theories. The earliest system that is fit to be called scientific is the Sāṃkhya. According to it, the whole world with all its diversity—everything of the nature of unorganised matter, all the plants and the entire world of animals—everything is basically and essentially material. This diversity includes not only the inert mass but also the active forces and conscious processes, yet all this is derived by evolution from one primeval matter. This system cannot be called fully materialistic, for here the conscious processes do not invariably arise out of the material ones, and a special conscious constituent is assumed to exist separately from matter. This conscious constituent is present in the process of evolution of matter, as it were, but it does not participate in it. By itself, it is absolutely inactive. All psychical processes are the processes of matter and special material forces. But among the constituents of matter, there is one that is akin to the spiritual one and is capable of perceiving and reflecting its static being. This spiritual element can, however, be safely ignored, for it plays no role in the process of evolution of matter. In all other respects, the system is fully materialistic, for the whole complex process of evolution is accomplished by matter from out of its own forces without any outside interference or control of the conscious will. Therefore, in the beginning of the universe, we have only one shapeless, indivisible, unbounded, all-pervading, indestructible, eternal primeval matter which none has created and none controls. But its unity and immobility are caused only by the fact that the

forces flowing in it are linked in a state of equilibrium. When this equilibrium is destroyed under the influence of undetermined transcendental causes, the primeval matter is found to have three different constituents—i.e. the constituent mentioned above, which is capable of developing into consciousness ; the opposite constituent of inert mass ; and the active constituent of forces or energies, under the influence of which the whole process takes place. These energies are conceived as a constituent, which has no mass or weight but has a quantum in every real product of matter. All the three constituents—mass, energy and the conscious—are inseparably linked to each other. The primeval matter is a continuous limitless substance consisting of infinitely small particles of these three inter-acting constituents. The nature of their inter-action is such that one cannot exist independently of the others. Energy cannot exist without mass ; the conscious presentations do not occur without energy. The presentation finally obtained, however, depends on the constituent that is predominant. Thus, for instance, a material body in a state of rest shows the predominance of mass ; the energy is linked here but the conscious constituent is not at all developed. The same body in motion shows the dominance of the constituent of energy ; the mass i.e. resistance is overcome and the conscious constituent is not developed. In a conscious wilful motion, the appearance of energy is due to the predominance of conscious constituent and the presence of the inert constituent is expressed in the overcoming of hindrances. In the primeval matter also, all the three constituents do not come into being, for which it is necessary that here and there one of them should become dominant and thus release a part of the interlinked constituents. The process begins when the individual particles of the three constituents scattered indifferently in the primeval matter, arrange themselves to form a whole under the influence of natural affinity. This results in uneven pressure in various parts of matter, and the single undifferentiated matter yields to various bodies which go on forming gradually—all different from each other.

Unlike in the atomistic systems, evolution does not take

place here by the accumulation of atoms. The atoms are there but they are formed later : there are still three stages of infra-atomic development and the atom is not the first one. Every atom has all the three universal constituents of primeval matter. The evolution generally takes place in the matter as a whole ; it is described as the process of transformation of homogeneous, indeterminate and undifferentiated mass into heterogeneous, determinate and organised bodies. In the process of evolution, nothing is added or taken off ; matter can be neither created nor destroyed. The sum-total of matter as a whole—its three constituents—remains constant, if all its states, actual and potential, are taken into account. The elements of matter are in eternal motion, which cannot stop even for a single moment. Any material process—any growth or decay—is nothing but a redistribution of the particles of matter, its transition from past to present, from present to future or from potential to actual state. The redistribution of mass and energy gives rise to all the diversity of material world, plants and animals. The process of evolution of primeval matter begins when its three component constituents are separated from each other. Later, this separation becomes obvious. All the Indian systems are formulated on the basis that matter, fully determinate and cognizable, consists of a number of sensual qualities—of smells, tastes, touches, colours and sounds. We know of no other matter outside these qualities. Therefore, there are five forms of matter corresponding to our five senses. Though they are called earth, water, fire, air and ether, what is however meant by these is only the various agents causing their respective sensations. Thus, in the evolution of matter, bifurcation takes place along two different lines : one—for the products with the predominance of the element capable of forming consciousness, thus giving rise to substances with consciousness and sense organs ; and the other—where inert matter is predominant, and we get its five forms corresponding to five senses. First, matter is formed—though differentiated yet subtle, containing only the capacity of showing the respective qualities. Thereafter, further evolution takes place, when these elements

are condensed into real sensual qualities.

This is how this process takes place : at first, in the most subtle rarefied primeval matter, are formed separate points of rotatory motion—whirlwinds of its type—containing potentially the capacity of sound. Then, these points are so condensed that the real atom of ether is formed out of them. This atom having its special energy decomposes under the influence of the same primeval released energy and creates a new centre of new energy, generating the possibility of touch in it, which then forms an atom of matter of touch. The material atoms of fire and of taste and smell are also formed in the same manner. Thus every subsequent atom possesses all the qualities of the previous ones so that the atom of hard matter possesses all the sensual qualities—sound, taste, touch, heat and finally smell.

VAIŚEṢIKA SYSTEM

Other Indian atomistic systems originated from the notion of infinitely small dimension. In the most ancient literature, there are speculations on the infinitely small bodies. The soul, conceived as the body having absolutely no dimension, was at that time considered such an entity. In the Vaiśeṣika system, the atoms are divided into complex—having minimum dimension,—and simple or dimensionless mathematical points. These points, however, have potential qualities—corresponding to the four main senses—on the basis of which they are divided into four categories. In the system, sound and its corresponding element, ether, do not have atomic structure. Ether only fills the empty space between the dimensionless points of simple atoms. In order to form a complex atom it is necessary to have at least six such dimensionless points which, together with ether filling the space between them, form something like a prism. It is only homogeneous atoms of the same category that can form a complex atom ; the heterogeneous simple atoms cannot form anything. Since in simple atoms, the qualities are only

potential—in the forms of imperceptible forces—it is necessary that some homogeneous points should arrange themselves in a special compound, which is called creative and is analogous to the chemical one. In matter as existing in the universe, atoms cannot exist freely without combination with others. Any specific quality is always traced back to a compound of two atoms with potential qualities of the same type. The only exception is air which, some scholars opine, is the aggregate of free atoms —which, so to say, do not join the chemical compound. The Vaiśeṣika system did not in any way negate the fact that bodies consist even of heterogeneous atoms having different qualities ; but these so-called extraneous qualities will have only subordinate and secondary importance in the formation of the body. A body consists mainly of matter ; the atoms of other categories only further the main process of formation of the body. The temperature developed in the chemical processes always presupposes the existence of solid so-called earth atoms. Neither air nor water can heat up by itself.

THE ATOMIC THEORY OF THE JAINAS

The theory of the Jainas is distinguished from the Vaiśeṣika system in that the former assumes the existence primarily of the homogeneous atoms only—those of matter, in general. Each atom is an infinitely small quantity and is, by itself, devoid of qualities. These qualities, however, do exist potentially; each atom thus possesses taste, smell, colour, temperature and other special tangible qualities which can cause amalgamation of atoms forming new bodies. For this, mere neighbourhood of the atoms is not enough; more of mutual conjunction is necessary, for which they must have opposite qualities. Two homogeneous atoms cannot blend together. One must be, so to say, positive and the other negative—or, if they are homogeneous, the intensity of one quality must be at least more than twice that of the other. When two atoms of opposite qualities blend together, something like mutual attraction takes place betwen them. If the amalgamation is caused by the intensity

of one element, the higher degree of intensity absorbs the lower one. All changes in the qualities of compounds are explained by the nature of their mutual attraction.

THE ATOMIC THEORY OF THE BUDDHISTS

The most interesting atomic theory in India is perhaps that of the Buddhists. They generally started by negating the existence of every eternal substance. They pictured the world as a photoplay consisting of unique flashes of light. Strictly speaking, there is no matter; there exist only forces. At first, it was the existence of spiritual substance only that was denied. This gave rise to a controversy between the Brāhmaṇas and the Buddhists on the existence of soul. The Buddhists, on the whole, were great negaters. They negated the existence not only of God and soul, but also of every substance. The soul was replaced by separate mental elements or ideas and matter by individual forces. The flashes of these forces were not in any way connected with each other; they did not belong to any substance. They were linked to each other in the regular whole of the universe only by the fact that their appearances or flashes were regulated by laws of strict causality. Just as the light of a lamp appears to an observer as a lasting object—in reality, there is a new flash of light every moment—exactly so, all other material elements, i.e. colour, sound, taste, smell and touch are nothing but a chain of recurring flashes. Thus, an atom is nothing but a momentary flash, appearing according to specific laws in relation to all other flashes which the world consists of. But not a single atom like this is ever met in nature. We have in nature only complex atoms, each atom having at least eight parts of which four are of the nature of primary forces, and the other four—of dependent secondary forces. The primary forces are earth, water, fire and air, but what we actually mean by these is the forces of reflection, adhesion, heating and movement. Thus the complex atoms and everything that consists of them possess these four forces. For instance, a flame has a motion, a temperature, an arrange-

ment of particles and a certain elasticity—and because of the presence of these forces in the basic element—the complex atom. Besides these four basic forces, each such atom has four secondary qualities, namely, the atom of colour, the atom of taste, the atom of smell and the atom of touch. Each of these secondary qualities is an individual element, linked to the rest only in the sense that it appears simultaneously—or, in other words, simultaneously flashes out. Here, there should be four basic atoms for every secondary atom. The atom of organized matter, which the living bodies consist of, is still more complex in structure. The whole living body is represented as covered with thin matter, which is compared with the light matter appearing in scintillation, when emanating from a precious stone. It has no weight; it cannot be dissected since a hard object can pass freely through it. After death, it vanishes without leaving any residue; no trace of it is found in the dead body. It also has atomic structure. In the same way, we have secondary atoms of matter, which are living, visual, auditory, and which can perceive the smells, the tastes and the touches. In this case too, each moment of such matter cannot appear without the support of the four basic forces.

MEDICINE

Coming to the field of experimental sciences, it is necessary first to note the advancement of the Indians in chemistry and botany. Both these sciences had practical importance as necessary branches of medicine. The Indians regard medicine as the oldest of the sciences and, in all probability, its sources were borrowed from the Babylonians. The Indian medicine originated from the notion that a body remained healthy if there was equilibrium between the three basic secret fluids, which are there in a human and animal body and are controlled by the normal performance of its functions.

These concepts, on the whole, corresponded to Hippocratic humoral pathology. They were passed on by the Arabs to the

medieval Europe where they held sway right upto the beginning of the nineteenth century. But it is difficult to say whether these notions were borrowed by the Greeks from the Indians, or reversely, by the Indians from the Greeks. It is probable that their medical concepts, as those of the other peoples, have been taken from ancient Babylon. In any case, there has been an active exchange of medical knowledge between both the cultured peoples of that time, which is evident from the large number of important prescriptions for various diseases. In fact, these ideas of humoral pathology were only the theoretical side of the affair. They did not at all interfere with accurate observation, not to speak of experimentation. The Indian medical literature gives us a number of fine descriptions of various diseases and of the medicinal effects of various herbs and preparations. However, the specialists in the field opine that Indian achievements are far behind those of the Greeks. The physiological concepts of the Indians are not based on observation, for the Indians were afraid of touching a dead body because of their religious convictions. In this field, they did not have the precise knowledge; the whole picture of human body and its physiological functions were drawn purely on the basis of the theory and the most irrepressible oriental fantasy.

SURGERY

Surgery was the most illustrious aspect of ancient Indian medicine. Since olden days, the Indian doctors were renowned for their surgical operations. In plastic surgery, they had achieved such perfection that the European surgery of the nineteenth century had to borrow some methods from them. Comparatively large number of cases of chopping of noses in punishment for various crimes had made it necessary that a nose be created artificially. Same is the case with the creation of artificial ears and lips. In the field of ophthalmology, the cataract was well-known to the Indians; they had described it in detail and had also given a method for removing it surgically. They were also fully acquainted with and widely applied

the most daring operations in cases of abnormal delivery, various methods of laparotomy and enterotomy. The number of sharp instruments used in these cases was 20 and that of the blunt ones—181. It is remarkable that in the decadent period of Indian culture, even surgery fell into decay. Though popular medicine generally continued to exist—and it exists even now along with modern medicine taught in the universities on European model—yet it is evident that the living conditions in the period of decadence were not conducive to its development. The atmosphere heretofore, in which the complicated operations were possible, was no longer there; the complex surgical methods, therefore, gradually fell into oblivion.

BOTANY

The advancement of medicine would have been unthinkable, if the sprouts of two other subsidiary sciences—botany and chemistry—were not there. The rich Indian flora gave rich material for gathering medicinal plants and studying their effects. In the treatises on medicine dating from the ancient period, we find descriptions of about five hundred herbs and their therapeutic uses. We also find various attempts at their classification, but these are very elementary and superficial. The Indian botany of the glorious period did not reach the stage when a scientific classification could be made.

During the later decadent period, when medicine itself started falling into oblivion, there was still less chance of having such a scientific classification. A specific branch of study was that of the toxic means—poisons and various herbs. In the still earlier period, when all was not quiet—viz. in the Maurya period(contemporary of the period of Alexander the Macedonian) when the Maurya dynasty was in power—poison was the usual means of political struggle of various groups in the courts : in the kitchen of every ruler, there always used to be a learned *brāhmaṇa*—an expert in poisonous substances—who was responsible for examining the food prepared for the ruler, so that there was no possibility of any poisonous substance being mixed.

CHEMISTRY

In ancient India, chemistry served medicine on one hand—in the preparation of a number of medicines—and technology on the other—for preparing colours, steels, cements, spirits, etc. Of the metallic medicines, mercury was particularly popular. The Indians could extract and purify mercury and use it for various complex preparations. Its medicinal effect was considered very strong. There was an assumption that it was possible to obtain such a perfect mercury compound that could give not only health but also immortality. The number of various mercury compounds known was as high as 18. There also existed a special school of chemists and alchemists, which endowed mercury with the importance of being the basic element of the universe. The Indians generally had knowledge of other metals and their oxides. They also knew that some of these were chemical compounds. They had various theories of chemical affinity and described practical preparation of various metallic salts. Fine sheets of metal were covered with salts and then heated. The well-known author of the Indian treatise on metallurgy, Nāgārjuna, gives directions for preparation of complex metallic salts and amalgams, and for the extraction, purification and precipitation of metals. He is, however, particularly known for his mercury compounds. Another famous chemist, Patañjali, is known for his invention of a special mixture (called *vidas*) which contained nitric acid. The chemists diligently engaged themselves in the preparation of complex substances from the simple and in the decomposition of the complex into simple ones. Various chemical processes generally described in the ancient treatises are those of extraction, purification, tempering, calcination, powdering, liquefying, precipitation, washing, drying, steaming, melting, filing, etc. Later, all these processes were applied to various metals, using special apparatuses and reagents and heating to different degrees—high, average and low. Though these methods had not been perfected, they did give the desired results, mainly by the use of various strong reagents containing nitric, sulphuric and

hydrochloric acids. The method of preparing silver nitrate from the ashes of plants and that of preserving caustic alkali in a metallic vessel so amazed the French chemist, Berthelot, that he doubted the authenticity of the Indian source. He surmised that the prescriptions had probably been borrowed from Europe and inserted in an ancient Indian treatise as a later addition. But it can be easily proved against him that the method has been described in all the earliest treatises; the information on the use of silver nitrate has been taken from the ancient Buddhist literature.

TECHNOLOGY

The progress of chemistry also influenced its practical application in technical production. Various methods for preparing cements had already been known to India since olden days. In the 7th century, a special method was invented for manufacturing cement. Its unusual strength, as seen in the old structures which are still not ruined even in the smallest degree, amazes us. The Indians say that it can withstand destructive influence for a milliard years. In the seventh century, we come across references to various specialists in structure of machines and apparatuses, in preparation of dyes, colouring matter, and also spirits and cosmetics. Three technical inventions have particularly enhanced the reputation of the Indian industrial technology and secured for it such excellence as that of the British industry in the 19th century. It is difficult to form even a slightest notion of the huge commerce that India conducted with the West in the ancient times. Not being in a position to export anything to India, the Roman Empire was economically shattered because of the huge amount of gold that had to be sent to India in payment for the Indian goods. Recently, a storehouse of Roman coins which had in it eighteen man-loads of gold coins was discovered in one place in India. The flourishing of this export trade was due to the superiority of Indian technology. Two of these three main inventions were the fast red dye prepared from a combination of madder with alums ;

and the blue dye extract prepared from indigo by a method which is analogous to modern chemical processes. Because of these inventions, India started meeting the demand for dyes of the whole cultured world of that time. In this respect, it had the same position at that time as that of Germany after the invention of aniline dyes. The third invention was an advanced method for tempering steel—which gave the so-called damask-steel to the middle ages.

MATHEMATICS

The greatest progress that the Indians made was in the field of mathematics, especially algebra and arithmetic. They have to their credit such achievements that were much in advance of those of the Greeks and are close to the modern European science.

In the field of geometry and astronomy, on the other hand, they were far behind the Greeks, and that is why they were strongly influenced by the latter. Since it is widely believed that Pythagoras borrowed his mathematical knowledge and his whole philosophy from India, it appears that this influence was reciprocal in the early stages. The famous Pythagoras-theorem was known to the Indians in the most ancient, the so-called Vedic age. But in the 2nd century A.D., we already see clear traces of Greek influence. The Indian astronomy was built up completely under Greek influence—borrowing from the latter everything right upto the whole range of terminology which was not even translated. In the 8th and 9th centuries, the Indians became teachers of the Arabs. The Indian astronomers were invited to the court of the Caliph in Baghdad. The Arabs then passed on the knowledge so acquired to the European West. Like all other sciences, the glorious period of Indian astronomy and mathematics dates from 5th-7th centuries—the time of the great Indian astronomers, Āryabhaṭa (5th cent.) and Varāhamihira (6th cent.). Their works were translated also

into the Arabic language and are studied even now by the special school of Indian astronomers, which continues to exist despite a totally different modern European astronomy taught in the universities. After 7th century, like all other fields of Indian life, astronomy too has its period of decadence—a static period—all under the influence of the same political conditions and war to which everything else had fallen a victim. Nevertheless, pure mathematics—algebra and especially arithmetic—continued to develop even in these difficult times. After the 11th century, however, with the complete disappearance of Buddhism from India, the leading mathematicians also disappeared.

The last well-known astronomer and mathematician, Bhāskara, lived in the 11th century. In this field, the Indians were apparently found to be more gifted by nature than all other peoples of the past. This special natural disposition of the Indians resulted in the amazing development of mathematical art. They invented a system of calculation by figures, to which values were assigned—depending upon their relative position alongside other figures. The Indians then passed on this indisputable invention of theirs to the Arabs and, through them, to the whole civilized world. The most important step in this system of figures was the invention of *zero* which we come across in the 5th century. It was, in all probability, invented a little earlier, but was, like all other Indian inventions, kept a secret—confined to the special school of scholars only. In the beginning of the 18th century, when the Russian system of education came in contact with the Tibetan system in Trans-Baikal, the system of figures was surprisingly found to be the same in both of them. Coming from India, this system completed a full cycle of migration and returned to India from the opposite end. As compared to all other nations, the Indian mind devoted much more attention to figures. This is seen from a study of Sanskrit where there are, from the olden times, special words for much higher numbers (this is not so in the languages of other peoples) in addition to the general Indo-European words for denoting "hundred" and "thousand". In

the most ancient epic, *Mahābhārata,* we find special words for denoting such numbers as hundred-thousand-billion.

Archimedes is known to have studied the problem whether the symbols available with the Greeks would be found adequate if it were necessary to count the particles of sand which our planet consists of. For the Indians, this would have been the least difficult, for there are words in Sanskrit language which can denote the highest numbers. Thus, it is not merely a matter of chance that the concept and the symbol of *zero* together with the whole decimal system of figures were invented in India and not anywhere else. Comparing the Indian mathematics with all other Indian sciences—physics, atomic theory, psychology, epistemology, metaphysics—we find that the Indian mind always approached the concept of maximum value from all aspects, irrespective of whether the value was intensive or extensive, and that it was this train of thought that ultimately found expression in the invention of *zero* for denoting the concept which had already been prepared and worked out from all angles. One of the later Indian mathematicians defined the value of *zero* as follows (his words are, of course, applicable even to the earlier period of Indian mathematics) :

> If we go on decreasing the divisor successively, the quotient will correspondingly go on increasing. If the divisor is reduced to the maximum possible limit, the quotient also increases to the maximum. But so long as the latter has some specific value, however high, it cannot be considered to have increased to maximum limit, for one can still find a higher value. The quotient is, therefore, an undefined value, and is rightly called infinite.

This is also the modern mathematical concept of maximum value. With its establishment, the transition of Indian science to the field of higher mathematics was completed. We find the same train of thought even in the field of physics—in the atomic theory. In the ancient Indian systems, an atom was regarded as the minimum possible value. But so long as it is still a specific value, it cannot be regarded as the minimum. The

Buddhist and Brahmanical systems, therefore, considered an atom a complex molecule—the result of the action of infra-atomic forces. Such infra-atomic forces are real mathematical points; they are infinitely small and have neither dimension nor time nor value. The real atom is formed by their special integration. We come across a similar course of thought in Indian psychology which states the complex character of even the simplest thought. If in a thought, there is no generalisation, no synthesis of past and present, or of the individual and the whole, it is totally empty—the so-called pure thought, which does not contradict any object, every object being the result of synthesis. Thus every thought, howsoever primitive, is the result of the synthesis of elements which have no psychic content or where the content is infinitely small. This thought is called emptiness, or *zero;* both the concepts are denoted by the same Sanskrit word—*śūnya.* The Indian epistemology and metaphysics both use the concept of maximum value as the point of departure in the formulation of their systems. In this connection, it is not surprising that the Indian astronomy was familiar with the principles of differential calculus. This information took the British astronomers by great surprise. But, after additional data were placed before them, they had to acknowledge that the method employed by the Indians in the 12th century for finding out the longitude of the planets was closely similar, if not identical, to the formula employed in modern mathematical astronomy.

The Indians differentiated between the velocity of a planet measured roughly and that measured accurately. They had special technical terms for denoting velocity during a small indefinite interval of time. The difference between finite time and indefinite or infinitely small time is also mentioned. The Indian astronomers had a special term for denoting a particular small unit of time, approximately equal to 1/34000th part of a second. For calculating the so-called momentary motion of a planet, i.e. the motion during a mathematical moment, Bhāskara compares the successive positions of the planet. For this, he regards the velocity of the planet as constant during

the respective interval of time, which is thus not more than 1/34000th part of a second approximately but may be even less. This momentary motion is, therefore, a differential concept—the differential planetary longitude. It is thus clear that the concept itself of the momentary motion and the method of determining it were known to Bhāskara; he can, therefore, be acknowledged as the predecssor of Isaac Newton in the discovery of the principle of differential calculus.

In Sanskrit, the scientific exposition was almost always in metric form. For almost every concept, therefore, it was necessary to have a number of synonyms so that the word, most befitting to the verse, could be selected. All the mathematical concepts and figures have a whole mass of synonyms, determined on the basis of some associations. For instance, the word for "eye" denotes the figure 2, and the word for "season"—the figure 6. In one of our earliest sources, *zero* has been called emptiness, that is, it is denoted by the same word (*śūnya*) which, almost in the same period, has been used in one of the Buddhist systems for denoting the concept of limit with regard to the relativity and changeability of the whole empirical world. In this source, *zero* is still not denoted by a circle but by a point. But among the many synonyms used for denoting *zero*, the word *ambara* which means "sky" or "empty space" became more widespread subsequently. Probably this is how *zero* came to be represented by a circle—empty from inside.

Though the progress in the field of mathematics—especially calculus—continued in India somewhat longer than that in all other sciences, this too nevertheless came to an end. No more distinguished mathematicians are found after the 12th century —the period following the Muslim conquest. However, the Indian achievements in this field are acknowledged as highly significant. The Indians are rightly considered the direct predecessors of J. Lagrange. The Indian arithmetic enumerates six simple arithmetical rules. Raising to the second and third power and taking square-root and cubic-root are included in simple rules. Of the higher mathematical rules, the Indians were familiar with the summing up of arithmetical series,

geometrical progressions, irrational square-root, solving of definite and indefinite equations of first degree right upto the solving of indefinite equations of the second degree. At this point, their achievements came to an end ; their direct successor here is J. Lagrange, who had to discover again and develop this process further. Thus, in the field of mathematics, the achievements of the Indians are the greatest as compared with those of the other ancient peoples. It is to them that the whole civilized world is indebted for the invention of our system of figures—so unjustly called Arabic. It is high time that their real name—the Indian—is restored to them. From what has been stated above, it is clear that these achievements were not merely a matter of chance, but had been worked out by incessant hard work in all provinces of abstract thought.

By thus reviewing the history of India, we see that it had its epoch of cultural progress, which, however, was soon arrested under the effect of unfavourable historical conditions. Undoubtedly, we are at present at a sharp turn in the history of Indian scholarship...

[Translated from Russian by H.C. Gupta]

ATOMIC THEORY IN INDIAN THOUGHT

H. JACOBI

In the oldest philosophical speculations of the Brahmins as preserved in the Upaniṣads, we find no trace of an atomic theory; and it is therefore controverted in the *Vedānta Sūtra,* which claims systematically to interpret the teachings of the Upaniṣads. Nor is it acknowledged in the Sāṃkhya and Yoga philosophies, which have the next claim to be considered orthodox, i.e. to be in keeping with the Vedas; for even the *Vedānta Sūtra* allows them the title of Smṛtis. But the atomic theory makes an integral part of the Vaiśeṣika, and it is acknowledged by the Nyāya, two Brahmanical philosophies which have originated with, or at least been favoured by, secular scholars (paṇḍits), rather than by divines or religious men. Among the heterodox it has been adopted by the Jains, and, as is stated in the *Abhidharmakośavyākhyā,*[1] also by the Ājīvikas. It seems to have been unknown to original Buddhism; for the well-known Pali scholar, Professor Franke, states that no mention is made of it in the Pali canonical books. It is different, however, with the Northern Buddhists; for the Vaibhāṣikas and Sautrāntikas were adherents of the atomic theory, while the Mādhyamikas and Yogācāras opposed it, as they declared the external world not to be real.

The speculations of the sects and philosophical schools just mentioned may be arranged in three groups. The first is represented by the Jains; the second by the *Vaiśeṣika* and *Nyāya Sūtras* and the *Bhāṣya* on the latter by Vātsyāyana, and, on the other hand, by the Northern Buddhists; while the last phase of the theory is that which appears first in the *Praśastapāda Bhāṣya,* the oldest systematic exposition of the Vaiśeṣika system, and has since been generally adopted by the combined Vaiśeṣikas and Naiyāyikas.

1. The passage is quoted *s.v.* 'Aṇu', in a Buddhist Dictionary, now (1908) being printed in Calcutta, for the proofs of which the present writer is indebted to the courtesy of Prof. de la Vallee Poussin.

I. We place the Jains first, because they seem to have worked out their system from the most primitive notions about matter. These may be taken to be the following. Matter is an eternal substance, undetermined with regard to quantity and quality, i.e. it may increase or diminish in volume without addition or loss of particles, and it may assume any forms and develop any kind of qualities. Material substances may coalesce into one substance, and one substance may divide into many.

Now, the Jains maintain that everything in this world, except souls and mere space, is produced from matter *(pudgala)*, and that all matter consists of atoms *(paramāṇu)*. Each atom occupies one point *(pradeśa)* of space. Matter, however, may be either in the gross states *(sthūla, bādara)*, or in the subtle *(sūkṣma)*. When it is in the subtle state, innumerable atoms of it occupy the space of one gross atom. The atoms are eternal as regards their substance; each atom has one kind of taste, smell, and colour, and two kinds of touch. These qualities, however, are not permanent and fixed for the several atoms, but they may be changed and developed in them. Two or more atoms which differ in their degree of smoothness and roughness, may combine to form aggregates *(skandha)*. The figures formed by the arrangement of the atoms into groups are manifold, and are precisely described in the *Bhagavatī* : everything is believed to be formed of groups of one kind only. The atom may develop a motion of its own, and this motion may become so swift that by means of it an atom may traverse in one moment the whole universe from one end to the other.

It is evident, from what has been said, that there are not different kinds of atoms corresponding to the four elements, earth, water, fire, and wind; but though it is not explicitly stated, still we may assume that the atoms, by developing the characteristic qualities of the elements, become differentiated and thus form the four elements. For the latter are presupposed by the belief in elementary souls : earth-souls, water-souls, fire-souls, and wind-souls, i.e. souls in various phases of development, which are embodied in particles of earth, etc. The elements must accordingly be regarded as the bodies, or even

corpses, of particular living beings; at any rate they are not without beginning and end.

We must mention the opinion of the Jains concerning *karma*, i.e. merit and demerit, in its bearing on the atomic theory. *Karma* according to them is of material nature *(paudgalika)*. The soul by its commerce with the outer world becomes literally penetrated with material particles of a very subtle kind. These become *karma* and build up a special body, the *kārmaṇaśarīra*, which never leaves the soul till its final emancipation. Thus the atoms of which the *karma*-matter is composed are believed to be invested with a peculiar faculty which brings about the effects of merit and demerit. The opponents of the Jains understood this theory to mean that *karma* is the property of atoms, and produces a motion in them so that they combine to form the body, and that the internal organ enters it.[2]

II. In our second group the conception of atoms has been combined with that of the four elements in the following way. There are four distinct kinds of atoms corresponding to the four elements, earth, water, fire, and wind; and the distinctive qualities of the latter are already found in the several atoms. Now, the belief that all material things are made up of four elements, singly or jointly, was current in India probably long before the philosophical systems of which we are speaking came into existence. We first meet it in the *Chāndogya Upaniṣad* (vi. 2 ff). There it is said that the *Ens absolutum* created fire, fire created water, and water created earth (*anna*), and that these three elements combining produce all existing things. In other places, wind *(vāyu)* is regarded as an element, and at last space *(ākāśa)* was reckoned as the fifth element ; for it seemed proper that there should be five elements corresponding[3] to the

2. *Vātsyāyana* p. 191, and *Vācaspati's* remark in the footnote, and *Nyāyavārtika*, p. 448.
3. This subject is treated at some length in Dr. Sukthankar's dissertation, "Teaching of Vedānta according to Rāmānuja", in *Wiener Ztscher. f. d. Kunde d. Morgenl*, xxii.

five organs of sense. This theory of the five elements has been adopted in the Sāṃkhya philosophy, and there it has been further developed by distinguishing two sets of elements, subtle *(tanmātra)* and gross *(mahābhūta)*. The elements in Sāṃkhya are, however, not atomic or eternal, but are developed from primeval matter *(prakṛti)* by a process which need not be detailed here. Of these traditional five elements, the fifth, *ākāśa*, has a peculiar character of its own, as it is not considered to enter into combination with the other elements, but to be a simple, i.e. an infinite and continuous, substance; nor did Buddhists even reckon it among their elements *(mahābhūta)*. And the Vaiśeṣikas also, who distinguished space *(diś)* from *ākāśa*, the substratum of sound, count the latter among the simple and infinite substances *(vibhu)*, together with space, time, and the souls. Accordingly, both Brahmanical and Buddhistic atomists admitted only four atomic substances, viz. earth, water, fire, and wind. But in other details their opinions vary.

As we have as yet but defective and secondhand information about the atomic theories of the Buddhists; we shall first describe that of their opponents, the Vaiśeṣikas and Naiyāyikas.

1. Vaiśeṣika being chiefly concerned with physics, and Nyāya with metaphysics and dialectics, the physical side of the atomic theory was more the province of the former, and the metaphysical of the latter system. Hence it may be supposed that the atomic theory is more intimately connected with the Vaiśeṣika system, and indeed Bādarāyaṇa regards it as their cardinal tenet.[4]

The opinions of the Vaiśeṣikas on atoms and their qualities, as well as the arguments connected therewith, are epitomized in a few aphorisms of the 4th and 7th chapters of the *Vaiśeṣika Sūtra* by Kaṇāda. They reasoned in the following way : Things that exist and are not produced from a cause are eternal; they may be inferred from (the fact that all known things are) products. Besides, as we call everything we perceive non-eternal, this idea of non-eternity presupposes eternity (iv. 1. 1-4). And

4. *Vedānta-sūtra* ii. 2.11 ff, and Śaṅkara's remarks on ii. 2. 1

finally the fact that we do not perceive the ultimate, i.e. uncaused, causes of things, constitutes our ignorance, and thus we are forced to assume that these ultimate causes are eternal.

But there is another interpretation of the last *sūtra* (iv. i. 5), which consists only of one word, 'ignorance'; i.e. as we can imagine no other cause of the destruction of a thing than the disjunction or destruction of its causes, it follows that the last causes must be eternal.

For the interpretation of the *sūtra*-s here given the writer relies not so much on the modern commentaries (for there is no old one in existence), as on their refutation by Śaṅkara, which shows us what was the meaning attached to them more than a thousand years ago. It is to be understood that these eternal things, the causes of the non-eternal ones, are the atoms; but they are not visible. For the *sūtra* goes on to declare that a great thing may be visible, if it has many constituent parts and possesses colour (iv. 1. 6). The next *sūtra* (not in our text, but as quoted in the *Nyāya Vārtika*, p. 233) states that the atom is invisible, because it is not composed of material parts. Now, a thing is great if it is composed of many constituent parts, or if the parts themselves are great, or if they are arranged in a peculiar way (vii. 1.9, not as in our text, but as quoted by Śaṅkara on *Ved. Sūt.* ii. 2.11). The reverse of this holds good with the small *aṇu* (i.e. atom); that is to say, the atom is not composed of parts.

The discussion, carried on in the next *sūtra*-s (10-20), comes to this. The expressions 'great, small, long, short,' as used in common parlance, are relative terms, the same thing being called great with reference to one thing and small with reference to another. These expressions refer to great (or long) things only, since only such are visible, and therefore they are used in a secondary meaning. In their *primary* sense 'great' and 'small' are not relative terms, but denote distinct kinds or *genera* of dimension (just as red and blue are different kinds of colour). For otherwise we should speak of great or small greatness,i.e. we should attribute qualities (great or small) to a quality (greatness), which would be against the principle that qualities

have no qualities. Greatness and smallness are non-eternal in non-eternal things; in eternal things they are eternal, i.e. absolute or infinite. The absolutely small is called globular *(parimaṇḍala)*.

About the other properties of the atoms we have the following statements. The qualities of earthen and other things—colour, taste, smell, and touch—vanish on the destruction of the thing itself; accordingly, they must be eternal in eternal things, i.e. in atoms. And so they are in the atoms of water, fire, and wind. In earth, however, as well as in atoms of earth, (some) qualities are *pākaja,* i.e. changeable by heat (vii. 1. 1-6). Different atoms may come into conjunction (iv.2.4). In the beginning of creation the atoms are set in motion by *adṛṣṭa,* i.e. merit and demerit of creatures in the past period (v. 2. 13). The internal organ also is an atom (vii. i. 23).

This is all the information about atoms we can gather from the *Vaiśeṣīka Sūtra.* But, short though it be, it is enough to show us the actual state of the atomic theory at the time of Kaṇāda and the arguments used by him in establishing that theory. Two things deserve to be noticed. First, the word for 'atom' used in our text, and, it may be added, in the *Nyāya Sūtra* too, is *aṇu*; only in the *sūtra* quoted in the *Nyāya Vārtika* do we meet with *paramāṇu,* the usual form with all later authors; but this may be a mistake of the Vārtikakāra, who quoted from memory. Secondly, the argument for the existence of atoms, which is based on the impossibility of unlimited division of a thing, was not yet made use of by the author of the *Vaiśeṣika Sūtra.*

2. In the *Nyāya Sūtra* by Gautama, and especially in the *Bhāṣya,* or old commentary on it by Vātsyāyana, who wrote in the 5th cent. A.D. or earlier, some aspects of the atomic theory are discussed, and objections raised to it by opponents are refuted. Gautama shared the opinions of the Vaiśeṣikas on the physical properties of the atoms described above. For, since he incidentally remarks (iv. 1. 67) that the black colour (of earthen atoms) is not eternal (though existing from eternity), it follows that he considered the properties of water, fire, and

wind to be eternal. The metaphysical questions, however, relating to atoms are fully discussed by Gautama, and further explained by Vātsyāyana. In the two places (ii. 1. 36 and iv. 2. 14 ff) where they occur, they are brought in at the end of the discussion of the 'whole and its parts'. The Naiyāyikas maintain that the whole is something more than its parts; it is a different thing *(arthāntara)*, not separated from its parts, but rather something in addition to them. We perceive the whole thing as such, e.g. a tree, though we see only the front parts, and not the middle and back ones; and thus we see a thing though we cannot see the atoms of which it consists. The question of atoms is then discussed in this way. A thing consisting of parts is called a whole, but each part must again be considered as a whole, and so the parts of a part, and so on *ad infinitum*. If we never could come to last parts, we could not conceive the idea of the whole, and so the whole would be dissolved into nothing. But the division reaches its limit in the atom, which cannot be divided any further, as we assume it to be absolutely small.

Another proof is the following. If the division into parts had no limit, the mote *(truṭi)* would not differ in size from the highest mountain, because both would have the same number of parts (iv. 2. 1 f.). The text then proceeds to refute objections raised against the notion of atoms as indivisible smallest things without parts. *Ākāśa* as the Vaiśeṣikas assert, is a simple all-pervading, and infinite substance : the question is put whether it penetrates the atoms or not. If it does, the atom must have parts ; if not, *ākāśa* would not be all-pervading. The reply is that the atom has no exterior or interior, nor is it hollow inside, but it is a simple, not a compound thing. It is further objected that, since the atom has a form, being globular, and since the form of a thing consists in the disposition of its parts, the atom must have parts. And again, when three atoms are in juxtaposition, that in the middle touches the one to the left with its right side, and that on the right with its left side; and when the atom is surrounded on all sides, we can distinguish six sides of the atom which must be considered its parts.

And if the six sides were reduced to one (i.e. if the atom were a mere point), then the aggregate of the seven atoms would take up no more space than one atom, and consequently a jar could be reduced to the size of an atom, and hence become invisible. These arguments are met by the declaration that the division of the atom into parts is not real, but a mode of expression only.

The following are some opinions on atoms, which are mentioned in the *Nyāya Vārtika* (6th cent. A.D.), but the authors of which are not named. Some thought that the mote which is seen in a ray of the sun entering a window is an atom. Others believed that atoms do not occur singly *(asaṃhata)*, but always in aggregates (p. 234). Some, apparently Buddhists, maintained that the atoms were not eternal, because they possess motion. The Naiyāyikas agree with the Vaiśeṣikas that the atoms are set into motion by *adṛṣṭa*, i.e. merit and demerit, but expressly state that God (Īśvara) directs the action of the atoms.[5]

3. The chief opponents of the Naiyāyikas, who held different views on atoms, were Buddhists of the Vaibhāṣika and Sautrāntika schools, as was said at the beginning. The Vaibhāṣikas maintained that external things can be directly perceived, the Sautrāntikas that they can only be inferred. Śaṅkara, who comprises both under the name of Sarvāstivādin, describes their opinions on atoms in his commentary on *Ved. Sūt.* ii. 2. 18 thus :

'These Buddhists acknowledge the four elements, earth, water, fire, and wind, with their properties and products, including the organs of sense; the four elements are atomic ; the earth-atoms have the quality of harshness, the water-atoms that of viscidity, the fire-atoms that of heat, and wind-atoms that of motion ; in combination these atoms form earthly things' etc.

More details we learn from the work of the Tibetan *'Jam-bzaṅ-bśad-pa*, of which Wassilieff has given an abstract,[6] from

5. *Nyāya-vārtika* p. 461ff
6. *Der Buddhismus*, pp. 298, 307f, 337 of the German tr.

the *Abhidharmakośa-vyākhyā*, a work of the idealistic school Yogācāra (for a transcript of which the present writer is inebted to the courtesy of Prof. de la Vallee Poussin), and from Prajñākaramati's commentary on the *Bodhicaryāvatāra* (ix. 8f., 95 f.).

The Vaibhāṣikas admitted that an atom had six sides, but they maintained that they made but one, or what comes to the same, that the space within an atom could not be divided. Their opinion has been disputed by the Naiyāyikas in an old verse quoted in the *Nyāya Vārtikā* (p. 521). They further asserted that atoms were amenable to sense-knowledge, though they were not visible apart, just as a dim-sighted man sees a mass of hair, though he connot see a single hair. This view, too, was disputed by the Naiyāyikas, who maintained that the atom is transcendental *(atīndriya)*, not perceptible to sense *(aindriyaka)*.[7]

The Sautrāntikas seem to have regarded the aggregate of seven atoms as the smallest compound *(aṇu)*.[8] Their opinion seems to have been that the (globular) atoms did not touch one another completely, but that there was an interval between them; but some held different views. All agreed that the atom is indivisible, though some admitted that it might be regarded as having parts, viz. eight sides. Both the Vaibhāṣikas and the Sautrāntikas declare that atoms are not hollow, and cannot penetrate one another.

Most points in the Buddhistical opinions which we have related are also discussed in the *Nyāya Sūtra*, *Bhāṣya*, and *Vārtika;* all the speculations on atoms we have dealt with in this our second group (the *Vaiśeṣika Sūtra* perhaps excepted) must, therefore, be regarded as having been current in the same period, i.e. in the beginning of our era down to the 6th cent. and later.

III. The latest improvement of the atomic theory consists in the assumption of *dvyaṇuka*-s, etc. It was first taught by Praśastapāda (p. 28), and is plainly referred to by Udyotakara; it was received as a tenet in all later works of what may be

7. *Nyāya-sūtra* ii. 1.36, iv. 2.14 ; cf. *Nyāya-vārtika* p. 232.

8. Cf. Hiuen Tsiang, *Si-yu-ki* i. 60. In Purāṇic measures 8 *paramāṇu*-s *equal to* 1 *parasūkṣma* (Wilson, *Viṣṇu-purāṇa* i. 93n).

called the combined Nyāya-Vaiśeṣika.[9] The fusion of these two schools began early, and seems to have been complete at the time when the *Nyāya Vārtika* was written; for in this work the *Vaiśeṣika Sūtra* is several times quoted simply as the *Sūtra* or *Śāstra*, and once (p. 222) its author is called Paramarṣi, a title accorded only to the highest authority. From that time *dvyaṇukas* are quite familiar in Sanskrit writers. It is assumed that two atoms *(paramāṇu)* form one binary *(dvyaṇuka)*, and that three or more[10] *dvyaṇuka*-s form one *tryaṇuka*, which is 'great' and perceptible by the eye. From *tryaṇuka*-s are produced all things. Modern writers further assume *caturaṇuka*-s, formed of four *tryaṇuka*-s, etc. The reasoning that led to this highly artificial theory is the following.[11] The rule that the quality of the product is derived from the corresponding quality of the cause does not apply to *dvyaṇuka*-s and *tryaṇuka*-s. For in that case the 'small' *dvyaṇuka*-s would produce a 'small' *tryaṇuka*, not a 'great' one as required. And if the smallness of the *dvyaṇuka*-s were produced from the like quality of the *paramāṇu*-s, it would be of a higher degree, just as two great things produce one greater thing; but the *paramāṇu* is that than which nothing smaller can be imagined. Therefore, it is not the dimension of the cause, viz. of the parts, which produces the peculiar dimension of the *dvyaṇuka* and *tryaṇuka*, but another quality : number. The number of the *dvyaṇuka*-s in the *tryaṇuka* has the effect of producing, on the latter, greatness, a dimension which differs in kind from that of its parts. *Dvyaṇuka*-s have been assumed for the following reason. As great things are of two kinds, eternal (viz. the infinitely great ones, e.g. space) and non-eternal, so both kinds must be found in 'small' things. Eternal small things are, of course, the atoms. Non-eternal ones must therefore consist of atoms; they are the *dvyaṇnka*-s.[12] Now number is produced by the 'notion which refers to many unities' *(apekṣābuddhi)*; and such a notion presupposes an intellect to form it; in our case it must be the intellect of one who perceives all the atoms and *dvyaṇuka*-s, and

9. *Nyāya-vārtika*, p. 448 10. *Śrīdhara*, p. 32.

11. Athalye's note to *Tarka-saṃgraha*, Bombay Sanskrit Series, p. 123.

12. *Praśastapāda*p. 131 and *Srīdhara* p. 133.

who therefore must be omniscient—that is, God. Without him in whose intellect the notion of duality in *dvyaṇuka*-s subsists, there would not be any *dvyaṇuka*-s or any *tryaṇuka*-s, and consequently there would not be anything whatever. This strange idea, found *in nuce* already in Praśastapāda, was brought forward by Udayana (12th cent.) as a proof of the existence of God.

Having passed in review all forms of the atomic theory which are known to us at present, we must now inquire into the origin of that theory. Two points appear to be of chief importance for our inquiry : first, that the name of atom is *aṇu*, 'small', or *paramāṇu*, 'absolutely small'; and secondly, that 'small' was generally considered to differ, not in degree but in kind, from 'great'. In accordance with this notion which is shared by all, even by the opponents of the atomic theory, the small, or, as we had better call it, the infinitesimal, had to be assumed as existing, and needed no further proof. The idea of the infinitesimal in this sense seems to have already been current in the time of the Upaniṣads, where we frequently meet with the statement that *brahman* is smaller than the small, and that the self *(ātman)* is small *(aṇu)*. In order to arrive at the conception of the atom, the idea of the infinitesimal had not only to be applied to matter, but it had, at the same time, to be joined to the idea of its indestructibility. Reasoning from analogy apparently came in to help; as the absolutely great, e.g. space, is acknowledged by all to be eternal, so that absolutely small, the atom, must also be assumed to be eternal. At any rate, the notion of the infinitesimal led, by easy steps, to the conception of the atom. It was probably in this early stage of development that the Jains took up the idea of the atom and made use of it in their metaphysical speculations. But in India the inventors of a new theory have generally been forgotten, and the fame attached to it went to those who succeeded in defending the theory against all opponents and in thus putting it on a base of firm reasoning. This task seems to have been performed by the

Vaiśeṣikas. For the atomic theory makes an integral part of their system, and in their *Sūtra* we find the outlines of the arguments used to establish it. Moreover, when the atomic theory is discussed in the *Vedānta Sūtra*, it is there ascribed to the Vaiśeṣikas, and at the same time treated as one of their cardinal tenets; we may therefore conclude that the author of the *Vedānta Sūtra* looked on the Vaiśeṣikas as the principal upholders, if not the authors, of the atomic theory.

When once firmly established, the atomic theory must have had much persuasive power with many philosophers; for it put in place of the primitive conception of matter as an eternal but quite undefined substance the more rational notions which offered an intelligible explanation of the perpetual change of things while still maintaining the eternity of matter. The Northern Buddhists adopted it, though they had to deny the eternity of atoms, according to the fundamental tenet of Buddhism that there are no eternal things. Even some adherents of Yoga admitted *paramāṇu*-s, defining them as the smallest particles in which the three *guṇas* are present.[13] The Mīmāṃsakas are said by Prajñākaramati to have acknowledged eternal atoms;[14] and the same holds good with the Ājīvikas, as stated above.

It must, however, be mentioned that Dr. W. Handt[15] has maintained the Buddhist origin of the atomic theory. 'Starting', he says, 'from the fundamental view of original Buddhism, which looked on the *saṃsāra* as continual springing into existence and perishing, they regarded the whole material world as an aggregate of non-eternal atoms, just as the spiritual one was produced by the aggregate of the five *skandhas*.' But non-eternity seems to reverse the idea of the atom as it is generally understood. And if, as Handt asserts, the Buddhists, in order to explain the perpetual flow of existence, 'naturally hit on the assumption of non-eternal atoms which are divided into four classes according to the four elements,' still it would seem not to have sufficed them even for that pur-

13. *Nyāya-vārtika* p. 251 f & *Yoga-Sūtra* i.40.
14. Comm. on *Bodhicaryāvatāra* ix. 127.
15. *Die atomistische Grundlage der Vaiśeṣikaphilosophie*, Rostock 1900.

pose. For the Sautrāntikas have brought forward their famous theory of the momentariness of all things *(kṣaṇikavāda)*. Every thing, according to this theory, exists but for a moment, and is in the next moment replaced by a facsimile of itself, very much as a kinematoscopic view. The thing is nothing but a series *(santāna)* of such momentary existences *(kṣaṇa)*. Here *time* is, as it were, resolved into atoms. This theory explains perfectly well the perpetual change of things, and apparently was invented for that purpose. Still, the Sautrāntikas retained the atomic theory alleged by Dr. Handt to have been invented by the Buddhists for the same purpose. We shall therefore not err in supposing that the Buddhists did not invent the atomic theory as a prop for their fundamental dogma, but advocated it because it belonged to the stock of physical and metaphysical ideas which passed current during the early centuries of the Christian era in Northern India.

ON THE SCIENTIFIC METHOD

BRAJENDRA NATH SEAL

THE DOCTRINE OF SCIENTIFIC METHOD

A study of the Hindu Methodology of Science is absolutely essential to a right understanding of Hindu positive science, its strength and its weakness, its range and its limitations. Apart from this rigorous scientifie method, Hindu Chemistry, for example, would be all practical recipe, or all unverified speculation. This, however, would be a very inadequate and indeed erroneous view of this early achievement of the human mind. That the whole movement was genuinely and positively scientific, though arrested at an early state, will appear from the following brief synopsis of the Hindu Methodology of Science.

CRITERION OR TEST OF TRUTH, AFTER THE BUDDHISTS

The ultimate criterion of Truth is found, not in mere cognitive presentation, but in the correspondence between the cognitive and the practical activity of the self, which together are supposed to form the circuit of consciousness. That knowledge is vaild which prompts an activity ending in fruition. (Cf. the distinction between *saṃvādi- and visaṃvādi-jñāna*. Also compare *pravṛtti-sāmarthyāt arthavat pramāṇam* : Vātsyāyana). Truth, the Buddhists contend, is *not* self-evidence, *not* the agreement between ideas, *nor* the agreement of the idea with the reality beyond, if any, for this cannot be attained direct, but the harmony of experience *(saṃvāda)*, which is implied when the volitional reaction, that is prompted by a cognition and that completes the circuit of consciousness, meets with fruition, i.e. realises its immediate end (with this compare Śrīharṣa, *Khaṇḍana-khaṇḍa-khādya*, on the relation of *pramā* to *loka-vyavahāra)*. This is the material aspect of Truth. The formal aspect is given in a principle which governs all presentations in consciousness, and

which combines the three moments of Identity, non-Contradiction and Excluded Middle in every individual cognitive operation...

PERCEPTION

The conditions of Perception, and its range and limits, were carefully studied. The minima sensibile (e.g. the minimum visibile, the Trasareṇu, the just-perceptible mote in the slanting sunbeam), the infra-sensible *(anudbhūta-rūpa, sūkṣma* sometimes termed *atīndriya)*, the obscured *(abhibhūta*, e.g. a meteor in the mid-day blaze), and the potential *(anudbhūta-vṛtti)*, are distinguished; but finer instruments of measurement were wanting, and this was a principal cause of arrested progress. It may be noted that the measurement of the relative pitch of musical tones was remarkably accurate (vide my paper on *Hindu Mechanics and Physics)*.

OBSERVATION (DARŚANA : VĀCASPATI AND UDAYANA)

The entire apparatus of scientific method proceeded on the basis of observed instances carefully analysed and sifted. This was the source of the physico-chemical theories and classifications, but in Anatomy the Hindus went one step farther; they practised dissection on dead bodies for purposes of demonstration. Ingenious directions are given, e.g., the body must be first disembowelled and wrapped round with the *kuśa* and other grasses, then kept immersed in still water for seven days, after which the medical student should proceed to remove the layers of the skin with a carefully prepared brush made of the fresh elastic fibres of green bamboos, which will enable the tissues, vessels and ducts to be observed. Post-mortem operations as well as major operations in obstetric surgery (the extraction of the foetus, etc.) were availed of for embryological observations (e.g., it is stated that the rudiments of the head and the limbs begin to appear in the foetus in the third month, and are developed in the fourth ; the bones, ligaments, nails, hair, etc,

becoming distinct in the sixth), and also embryological theories, e.g., the indication of sexual character in the second month by the shape of the foetus, the shape of a *round* joint indicating the male sex, and an *elongated* shape the female sex (cf. *Caraka*, Sūtrasthāna, Chap iv). In Phonetics (as in the *Prātiśākhyas*, *circa* 600 B.C.), in Descriptive and Analytical Grammar (as in Pāṇini), and in some important respects in Comparative Grammar (as in Hemacandra's Grammar of the Prākṛta Dialects), the observation was precise, minute, and thoroughly scientific. This was also the case in Materia Medica and in Therapeutics, especially the symptomology of diseases. In Meteorology the Hindus used the rain-gauge in their weather forecasts for the year, made careful observations of the different kinds of clouds and other atmospheric phenomena (e.g. they estimate the heights of clouds, the distance from which lightning is ordinarily visible or the thunder is heard, the area of disturbance of different earthquakes, the height to which the terrestrial atmosphere extends, etc. ; vide Varāhamihira, Śrīpati, and the authorities quoted by Utpala). In Astronomy the observation was, generally speaking, very defective, as in the determination of the solar and the planetary elements, and this was probably due to the lack of practical interest, but the determination of the lunar constants entering into the calculation of lunar periods and eclipses, matters in which the Hindus had a practical ceremonial interest, reached a remarkable degree of approximation (much above Graeco-Arab computations) to the figures in Laplace's Tables, which can only be explained by the circumstance that in the case of these constants the Hindus carried out for more than a thousand years a systematic process of verification and correction by comparison of the computed with the observed results (like the navigator's correction of the course of the ship at sea, a process which was termed *dṛggaṇitaikya*. In Zoology the enumeration of the species of Vermes, Insecta, Reptilia, Batrachia, Aves, etc. makes a fair beginning, but the classification proceeds on external characters and habits of life, and not on an anatomical basis. In Botany the observation was mainly in the interests of Materia Medica, and the classi-

fication was as superficial as possible. (Vide my paper on the *Hindu Classification of Plants and Animals*).

EXPERIMENTS

Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, e.g. Metallurgy, Pharmacy, Dyeing, Perfumery and Cosmetics, Horticulture, the making and polishing of glass (lenses and mirrors of various kinds are mentioned, the spherical and oval *vṛtta* and *vartula* being well known—Pliny indeed mentions that the best glass ever made was Indian glass). And the results of such experiments were freely drawn upon for building up scientific hypotheses and generalisations. But of experiment as an independent method of proof or discovery the instances recorded in books are rare. I may note one interesting example in Udayana's *Kiraṇāvali*, relating to the weight of air. Udayana argues that air must be a distinct and independent Bhūta, for if air were a form of the Earth-Bhūta, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says, by one who accepts the weight of air, that this argument is inconclusive; for a counter-experiment may be suggested. The balloon filled with smoke (or gas, *dhūma*) rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (or gas) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes. Vallabhācāryya, in the *Līlāvatī*, it is true, speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float or to come up to the surface of the water, but the description does not show that he had any clear idea on the subject. Mathurānātha, again, states that the determination of the degree

of purity (the carat) of gold by rubbing against the assaying-stone and observing the character of the yellowish streak against the black smooth background, is only an indirect means of ascertaining weight (*gurutva-vailakṣaṇya*, lit. specific gravity)—which seems to suggest that there was a more direct means of arriving at the latter. Probably this refers to the common Indian method of comparing the lengths and weights of wires of uniform thickness that can be formed by drawing different pieces of gold through the same diamond bore. I think it may be regarded as fairly certain that the Hindus were ignorant of Archimedes' discovery, an ignorance which, at any rate, they could not have well borrowed from the Greeks, no more than they could have thus borrowed their knowledge of things unknown to the Greeks themselves.

FALLACIES OF OBSERVATION

Mal-observation and Non-observation : These were carefully studied in relation to errors of observation, and hallucination (*bhrama, adhyāsa, āropa)*, which were ascribed to three causes : (a) *Doṣa,* defect of sense organ, as of the eye in jaundice, or of the skin in certain forms of leprosy (leading to tactile insensibility, cf. Suśruta), or defect of necessary stimulus, e.g. too faint light, or undue distance or nearness, in vision; (b) *Samprayoga*, presentation of a part or an aspect instead of the whole; and (c) *Saṃskāra*, the disturbing influence of mental predisposition, e.g. expectation, memory, habit, prejudice, etc.

THE DOCTRINE OF INFERENCE

Anumāna (Inference) is the process of ascertaining, not by perception or direct observation, but through the instrumentality or medium of a mark, that a thing possesses a certain character. Inference is therefore based on the establishment of an invariable concomitance *(Vyāpti)* between the mark and the character inferred. The Hindu Inference *(Anumāna)* is therefore neither merely formal nor merely material, but a combined

Formal-Material Deductive-Inductive process. It is neither the Aristotelian Syllogism (Formal-Deductive process), nor Mill's Induction (Material-Inductive process), but the real Inference which must combine formal validity with material truth, inductive generalisation with deductive particularisation.

An inference admits of a rigorous formal statement—in the shape of five propositions for dialectical purposes (i.e. in demonstrating to others)—or of three propositions when the inference is for oneself (*svārthānumāna*) :

(1) The probandum, the statement of the proposition to be established (*pratijñā*), e.g. yonder mountain is "fiery"; (2) the reason, the ascription of the mark (*hetu*), e.g. for it smokes; (3) the general proposition, stating the invariable concomitance which is the ground of the inference—clenched by an example, e.g. whatever smokes is "fiery", as an oven (*udāharaṇa*); (4) next, the application, the ascertainment of the existence of the mark in the present case (*upanaya*), e.g. yonder mountain smokes; (5) finally, the conclusion, the probandum proved (*nigamana*), e.g. yonder mountain is "fiery".

1. Yonder mountain is "fiery".
2. For it smokes.
3. Whatever smokes is "fiery", as an oven.
4. Yonder mountain does smoke.
5. Therefore yonder mountain is "fiery".

For inference for onself only the first three or the last three propositions are held to be sufficient.

The Hindu *Anumāna*, it will be seen, anticipates J. S. Mill's analysis of the syllogism as a material inference, but is more comprehensive; for the Hindu *udāharaṇa*, the third or general proposition with an example, combines and harmonises Mill's view of the major premise as a brief memorandum of like instances already observed, fortified by a recommendation to extend its application to unobserved cases, with the Aristotelian view of it as a universal proposition which is the formal ground of the inference. This Formal-Material Deductive-Inductive

process thus turns on one thing—the establishment of the invariable concomitance *(vyāpti)* between the mark and the character inferred—in other words, an inductive generalisation. The question is : what is our warrant for taking the leap from the observed to unobserved cases ? Under what conditions are we justified to assert a Universal Real proposition on the basis of our necessarily limited observation ?

THE CĀRVĀKA VIEW

Among the Cārvākas there were two classes, the cruder school of materialists who accepted perception *(pratyakṣa)* as a valid source of knowledge, as well as the reality of natural law *(svabhāva)*, and the finer school of sceptics, who impugned all kinds of knowledge, immediate as well as mediate, and all evidence, perception as well as Inference (vide Jayanta's reference in the *Nyāyamañjarī* to *Suśikṣita-cārvākāḥ*; also *cārvāka-dhūrtastu* etc. Āhnika 1.)

The Cārvākas hold that the principle of causality which the Buddhists assume to be a ground of an induction *(vyāpti)* is itself an induction (a case of *vyāpti)*, which amounts to reasoning in a circle *(cakraka)* ; that every inference is based on an unconditional invariable concomitance, which itself must be inferred, as universal propositions cannot be established by our limited perceptions, and thus there is a *regressus ad infinitum*, *(anādiparamparā)*, and that the *nexus* between cause and effect, or between the sign and the thing signified (e.g. smoke and fire), is only a mental step or subjective association based on former perception, a mental step which by accident is found justified by the result in a number of cases.

THE BUDDHISTS : THEIR ANALYSIS AND VINDICATION OF INFERENCE

The Buddhists, however, take their stand on the principle of the uniformity of Nature *(svabhāva-pratibandha : Nyāya-bindu)*. This uniformity, for scientific purposes, has to be divided into

two different relations : (1) the uniformity of succession in the relation of cause and effect, e.g. of smoke to fire *(tadutpatti : Nyāya-bindu)*; (2) the uniformity of co-existence (in the form of co-inherence in the same substrate) in the relation of genus and species, e.g. the relation of invariable concomitance expressed in the proposition "All Śiṃśapās are trees", which is not a relation of causality, but of co-existence or co-inherence in the same substrate (i.e. the co-inherence of the generic qualities of a tree with the specific characters of a Śiśu-tree in this particular individual before me, a Śiśu-tree), a relation which may be termed essential identity *(tādātmya : Nyāya-bindu)*. To these two the Buddhists add a third ground of inference, non-perception of the perceptible *(dṛśyānupalabdhi)*, which is employed in inferring the absence *(pratiṣedha)* of a thing from the non-perception of the thing or of something else. In all cases of inference based on the Uniformity of Nature, the relation is that of inseparableness or non-disjunction between the mark and the character inferred. The question is : how is this inseparableness *(avinābhāva)* ascertained, and what is the warrant of our belief in it in these cases ?

ASCERTAINMENT OF INSEPARABLENESS OR NON-DISJUNCTION : BUDDHIST ACCOUNT

First take the case of causation. The cause is the invariable antecedent of the effect. What is meant is that (a) a specific cause (or sum of causal conditions) is invariably followed by a specific effect, and (b) a specific effect (with all the distinctive and relevant accompaniments), is invariably preceded by a specific cause. It is not that clouds always lead to rain, or that floods in the river valley always imply rain in the hills higher up. But this particular conjunction of antecedent circumstances (e.g. the appearance of a particular kind of clouds accompanied by flashes of lightning, the roll of thunder and flights of Valākās—driven by the wind from a particular quarter of the horizon, and ascending in black masses, etc.) is as a rule the precursor of a particular assemblage of rain effects

(rain with particular accompaniments). Again this particular kind of flood (overflowing of the river-banks accompanied by muddy discoloration of the water, rapid currents, the bearing down of tree-trunks, etc.) is always preceded by rain in the hills higher up (though, no doubt, other cases of floods in a river may be due to a breach in an embankment or the melting of the snows). In other words, the Buddhists (and the earlier Nyāya school) avoid the difficulty arising from the plurality of causes by taking into consideration the accompanying phenomena, which, if properly marked, would always point to a specific cause of a specific effect, and *vice versa.*

I quote Nyāya authorities, but this device to obviate the plurality of causes is common to the early Nyāya and the Buddhistic systems. ...In other words, a single condition called a cause is not invariably succeeded by the effect, nor does the effect phenomenon in general point to any particular cause as antecedent, for there may be a plurality of causes of a general effect. The skilful observer will therefore select the full complement of causal conditions which is invariably succeeded by the effect, and also the specific effect (e.g. *dhūma-viśeṣa*) which points to a specific causal antecedent. Compare also Jayanta : "We infer an effect from a specific assemblage of causes". Similarly, "We infer a specific cause from a specific assemblage of effects". (*Nyāyamañjarī*, Āhnika 2, on *Gotama Sūtra* 5, Āhnika 1, Chap. 1).

A specific assemblage of causes, therefore, has only one specific assemblage of effects, and *vice versa.* Of course, the observer is to find out the essential or relevant features (as distinguished from the irrelevant ones) which, being included, will enable him to specify the particular cause of the particular effect.

Now, this being premised to be the exact meaning of the inseparableness or non-disjunction in the case of cause and effect, we come to the question with which we started : how is this relation to be ascertained or established between two phenomena or assemblages of phenomena ? Obviously, mere observation of their agreement in presence (*anvaya*) and their

agreement in absence (*vyatireka*) is no help in the matter. Take a concrete example. The ass is customarily employed to bring the fuel with which fire is lighted. In a hundred cases you have observed the ass among the antecedents of smoke. In a hundred cases you may have observed that when there is no ass there is no smoke. This is no warrant for concluding a relation of cause and effect between an ass and smoke. It may be that you happen to have never observed smoke without an antecedent ass, or an ass without smoke following. Even this is of no avail. It is not agreement (unbroken and uniform though it be) in presence or in absence, or in both, that can settle the matter. There is one and only one way of ascertaining the causal relation. Suppose *A* with certain accompaniments is found to precede *B* immediately. Now, if *A* disappearing *B* disappears, even though all other antecedents remain and there is no other change in the case, then and then only can the causal relation be ascertained. It is not a mere table of positive instances or negative instances ; it is this Method, which we may term the Method of Subtraction (the Method of Difference in its negative aspect), that is the only exact and rigorous scientific Method. Such was the statement of the earlier Buddhists (cf Udyotakara's and Vācaspati's report of the Buddhist doctrine of Inference : *sa hi pratibandho na darśanamātrāvaseyaḥ*)...

But the canon in this form is not sufficiently safeguarded against possible abuse. Two points have to be emphasised : (1) It must be carefully observed that no other condition is changed, (2) that the appearance and disappearance of *A* must immediately precede the appearance and disappearance of *B*. The definition of a cause is based on two fundamental characters : (1) the unconditional invariableness of the antecedence and (2) the immediateness of the antecedence. The canon of the Method of Difference must therefore be stated in such a form as to emphasise each of these aspects. And one main difficulty in the practical application of the canon is that along with the introduction or sublation of an antecedent, some other phenomenon may be introduced or sublated unobserved.

As a safeguard against this radical vitiation of the Method, the the later Buddhists formulated the canon of a modified Method, termed the *Pañcakāraṇī*, a Joint Method of Difference, which combines the positive and the negative Methods of Difference (the Method of Addition and the method of Subtraction) in a series of five steps, and which equally emphasises the unconditionality and the immediateness of the antecedence as essential moments of the causal relation. This is neither agreement-in-presence nor agreement-in-presence-as-well-as-absence (the foundation of J. S. Mill's Joint Method of Agreement), but the Joint Method of Difference. The *Pañcakāraṇī* runs thus :

The following changes being observed, everything else remaining constant, the relation of cause and effect is rigorously established :

First step—The "cause" and the "effect" phenomena are both unperceived.

Second step—Then the "cause" phenomenon is perceived.

Third step—Then, in immediate succession, the "effect" phenomenon is perceived.

Fourth step—Then the "cause" phenomenon is sublated or disappears.

Fifth step—Then, in immediate succession, the "effect" phenomenon disappears.

Throughout, of course, it is assumed that the other circumstances remain the same (at least the relevant or material circumstances).

This *Pañcakāraṇī*, the Joint Method of Difference, has some advantages over J. S. Mill's Method of Difference, or, what is identical therewith, the earlier Buddhist Method; and the form of the canon, bringing out in prominent relief the unconditionality and the immediateness of the antecedence, is as superior from a theoretical point of view to J. S. Mill's canon, and is as much more consonant than the latter to the practice of every experimenter, as the Hindu analysis of *Anumāna* as a Formal-Material Deductive-Inductive Inference is more comprehensive and more scientific than Aristotle's or Mill's analysis of the Syllogism (or Mediate Inference).

But even the *Pañcakāraṇī* is no sufficient answer to the question with which we started. The *Pañcakāraṇī* is only a method; it shows only how in a particular case the relation of cause and effect is to be established. But we want more than this—we require a warrant for the process. The Buddhists therefore supply the following proof of the Method : Doubt is legitimate, but there is a limit to doubt. When doubt lands you in an unsettlement of a fundamental ground of practice, and would thus annul all practical exercise of the will, the doubt must cease ; else the doubt would be suicidal or sophistical. In this particular case, when the *Pañcakāraṇī* is satisfied, the antecedent in question must be the cause, for there is no other antecedent to serve as cause; the proof is indirect but rigid. If this be not the cause, there is no cause of the phenomenon. It was not, and it begins to be, without a cause; which would be a contradiction of the rational ground of all practice, for all volitional activity proceeds by implication on the principle of causality. If things could happen without a cause, all our motives to action would be baffled. The link between a presentation and the instinctive volitional reaction would snap, and the circuit of consciousness would be left incomplete. In fact, the Buddhists go farther; they hold causal efficiency *(arthakriyā)* to be of the essence of empirical (relative) Reality. The proof of the Joint Method of Difference, then, lies in a strict application of the principle of causality in its negative form (viz., there can be no phenomenon without a cause), and the truth of this last is guaranteed by the same ultimate criterion of empirical (relative) Reality as the truth of Perception itself, viz. the correspondence between the rational and the practical activity of the self.

But invariable concomitance (or non-disjunction), the Buddhists argue, has another form, e.g. the relation of the genus to the species. We may have perceived a hundred instances of the association of certain characters with certain others ; we may also have never perceived the former when the latter were absent ; but this would not enable us to generalise and establish invariable and unconditional co-existence. We must be first satisfied that there is identity of essence *(tādātmya)*. It is

only when we perceive that the characters of a Śiṃśapā are co-inherent with the generic characters of a tree in the same individual object (a Śiṃśapā-tree before me), and when we further perceive that the characters are held together by the relation of identity of essence, that we can say that all Śiṃśapās are trees. For as there is identity of essence, a Śiṃśapā would not be a Śiṃśapā if it were not a tree ; it would lose its self-identity, which is a contradiction. Hence the relation of identity of essence, as in the relation of the species to the genus, is the sole ground for establishing uniformity of co-existence *(pratibandha)*.

For the Buddhist Method of Induction in its latter form, the *Pañcakāraṇī*, see *Sarvadarśana-saṃgraha* : Buddhist reply to the Cārvāka attack on Inference.

THE NYĀYA DOCTRINE OF INFERENCE

The Nyāya easily demolishes the Buddhist contention about identity of essence. The Nyāya writers, being realists, do not impugn the reality of the genus *(jāti)* like the nominalists or the nominalistic conceptualists; but they point out that the inseparableness (or non-disjunction) in such cases can only be established by the experience of unbroken uniformity. Uniform agreement in presence with uniform agreement in absence—not the mysterious identity of essence irresistibly perceived in any individual case or cases—is the only basis for constituting genera and species in natural classification. Indeed, some of the later Nyāya writers point out that individuals do not always possess in nature all the characters that go to form the definition of the class to which they are referred.

Similarly, as regards the relation of cause and effect, a *nexus* is sometimes fancied to be perceived, a power in the cause to produce the effect *(śakti)*, or an ultimate form *(jāti-saukṣmya)* which is supposed to be present whenever the effect (quality or substance) is produced (cf. Bacon's view of the "Forms" of Simple Qualities). All this is neither a matter of observation nor of legitimate hypothesis. There is nothing except the

invariable time-relation (antecedence and sequence) between the cause and the effect. But the mere invariableness of an antecedent does not suffice to constitute it the cause of what succeeds; it must be an unconditional antecedent as well *(anyathā siddhiśūnyasya niyata pūrvavartitā* being the definition of *kārya-kāraṇa bhāva)*. For example, the essential or adventitious accompaniments of an invariable antecedent may also be invariable antecedents; but they are not unconditional, but only collateral and indirect. In other words, their antecedence is conditional on something else *(na svātantryeṇa)*. The potter's stick is an unconditional invariable antecedent of the jar; but the colour of a stick, or its texture or size or any other accompaniment or accident which does not contribute to the work done (so far as we are considering it), is not an unconditional antecedent, and must not therefore be regarded as a cause. Similarly, the co-effects of the invariable antecedents, or what enters into the production of these co-effects, may themselves be invariable antecedents; but they are not unconditional, being themselves conditioned by those of the antecedents of which they are effects. For example, the sound produced by the stick or by the potter's wheel invariably precedes the jar, but it is a co-effect, and *Ākāśa* (ether) as the substrate and *Vāyu* (air) as the vehicle of the sound enter into the production of this co-effect; but these are not "unconditional" antecedents, and must therefore be rejected in an enumeration of conditions or causes of the jar. Again, the conditions of the conditions, the invariable antecedents of the invariable antecedents, are not unconditional. The potter's father is an invariable antecedent of the potter, who is an invariable antecedent of the jar, but the potter's father does not stand in a causal relation to the potter's handiwork. In fact, the antecedence must not only be unconditionally invariable, but must also be immediate *(avyavahita-pūrvakālāvacchedena kāryadeśe sattvam)*. Finally, all seemingly invariable antecedents which may be dispensed with or left out are *ipso facto* not unconditional, and cannot

therefore be regarded as causal conditions. In short, nothing that is unnecessary is unconditional. For this class, *vide* Viśvanātha, *Siddhānta-muktāvalī* on *Śloka* 20. For example, it is the custom to point to spatial position or direction with the fingers; but finger-pointing, though invariably present, is not causally related to the perception of direction or spatial position, because we can imagine such perception without finger-pointing: Vācaspati, *Tātparyyaṭīkā*, Chap. I, *Āhnika* 1, *Sūtra* 5.

Viśvanātha in the *Bhāṣā-pariccheda* mentions five kinds of *anyathāsiddha*, conditional antecedents. There are several classifications of these irrelevant antecedents.

The unconditional *(anyathā-siddhi-śūnya)*, as interpreted in this comprehensive sense, is a far more fruitful conception than Mill's, and is well adapted to its work—the elimination of the irrelevant factors in the situation. In the end, the discrimination of what is necessary to complete the sum of causes from what is dependent, collateral, secondary, superfluous, or inert (i.e. of the relevant from the irrelevant factors), must depend on the test of expenditure of energy. This test the Nyāya would accept only in the sense of an operation analysable into molar or molecular motion, but would emphatically reject if it is advanced in support of the notion of a mysterious causal power or efficiency *(śakti)*. With the Nyāya all energy is necessarily kinetic. This is a peculiarity of the Nyāya—its insisting that the effect is only the sum or resultant of the operations of the different causal conditions—that these operations are kinetic, being of the nature of motion, in other words, holding firmly to the view that causation is a case of expenditure of energy, i.e. a re-distribution of motion, but at the same time absolutely repudiating the Sāṃkhya conception of power or productive efficiency as metaphysical or transcendental *(atīndriya)*, and finding nothing in the cause other than an unconditional invariable complement of operative conditions *(kāraṇa-sāmagrī)*, and nothing in the effect other than the consequent phenomenon which results from the joint operations of the antecedent conditions. It may be noted that the Nyāya, while repudiating transcendental power *(śakti)* in the mechanism of Nature and

natural causation, does not deny the existence of metaphysical conditions like merit *(dharma)*, which constitute a system of moral ends that fulfil themselves in and through the mechanical system and order of Nature.

The causal relation, then, like the relations of genus to species, is a natural relation of concomitance *(svābhāvika-sambandha* : Vācaspati) which can be ascertained only by the uniform and uninterrupted experience of agreement in presence and agreement in absence, and not by deduction from a certain *a priori* principle like that of Causality or Identity of Essence.

NYĀYA OBJECTION TO THE BUDDHIST METHOD OF DIFFERENCE AS A MEANS OF ASCERTAINING CAUSALITY

Take for example the Buddhist deduction of Causality in any particular conjunction by means of the negative Method of Difference, or of the *Pañcakāranī.* The ascertainment of the causal relation by these Methods is open to the following objections : (1) The unconditionality of the antecedent cannot possibly be ascertained. As the Cārvāka rightly points out, the Methods enable you to eliminate irrelevant antecedents that are or can be perceived; but the introduction or sublation of latent or undetected antecedents can be imagined, against which the Method of Difference is powerless. In the case of the production of smoke, for example, by fire—what if I say that an invisible demon intervenes in every case between the fire and the smoke, that this demon *(piśāca)* is the immediate antecedent and real cause of the latter, and that the fire is an accident which in every such case is brought about by its own causal antecedents ? In saying this I do not go counter to the principle of causality, and am landed in no contradiction *(vyāghāta)* such as strikes at the very roots of all practice, or baffles the completed circuit of consciousness, however much I may violate probability.

(2) In the second place, even supposing that the fire in this particular ease (which satisfies the Method of Difference rigidly) is ascertained to be the cause of the smoke, how can I know

that fire is the cause in other cases, or that there is no other cause ? You will perhaps argue that if there were an *indefinite* number of causes of the same specific phenomenal effect, it would violate the principle that phenomena are all conditioned, i.e. exist only under certain conditions *(kādācitkatva)*, which is more comprehensive than the principle of causality, and the contradiction of which equally overthrows all rational practical activity. Yes, I accept the conditionality of phenomena, but this is not violated by supposing that one specific assemblage of phenomena has more than one cause. It is true that if you suppose such plurality of causes you cannot establish the invariableness of the particular conjunction (green-wood fire and smoke) which your Method of Difference fixes upon as a case of cause and effect; in other words, with your special principle of Causality so restricted, and without any general principle of Uniformity of Nature to fall back upon, you cannot ascertain from the present case, or from any number of similar cases that you may have observed, that all green-wood fires are followed by smoke, or that in a given case smoke has been preceded by fire—i.e., you are helpless in demonstrating (or ascertaining indubitably) the relation of cause and effect. But this is an objection against your own position, not mine. Why not admit at once that certain phenomena are naturally connected (as invariable concomitants or antecedents) with other phenomena, and take your stand on observed concomitance (uniform and uninterrupted experience of agreement in presence as well as absence) without assuming causality as an *a priori* principle and making deductions therefrom, and without the trouble of ascertaining the relation of cause and effect in every individual case ? I am free to admit that theoretical objections of irresistible force (like those of the Cārvāka sceptics) can be urged against this ascertainment of universal invariable and unconditional concomitance on the basis of mere observation. Doubts of this kind can no more be laid by my view of the matter than by your canons of causality and essential identity. Ultimately we all have to fall back on the rational practice of thinking persons, and such persons are always content to act on practical cer-

titude instead of hankering after an unattainable apodictic certainty in the affairs of life. This same practical certitude is also the ultimate warrant of the Deductive-Inductive Inference by which we ascertain the characters of things without direct perception and through the medium or instrumentality of a mark.

THE NYĀYA ANALYSIS OF THE CAUSAL RELATION (CONTINUED)

Co-effects : In the enumeration of different varieties of irrelevant antecedents, we have already noticed that co-effects of the same cause are apt to be confounded as cause and effect. In some cases the co-effects may be simultaneous, e.g. the case of the ascending and the descending scale in a balance, which are co-effects of gravity *(vide* Pārthasārathi Miśra on Kumārila, *Śloka-vārtika*, Śūnya-vāda *Śloka* 157). In other cases the co-effects may be successive effects of the same cause, and here the risk is great of mistaking the antecedent co-effect to be the cause of the succeeding co-effect, e.g. the case of ants moving to a line to carry their eggs upward, which is observed before the summer rains, where the movement of ants and the rains are not cause and effect, but successive effects of the same cause, viz. the heat *(uṣmā)*, which disturbs the elements, viz. the earth and the atmosphere *(mahābhūta-kṣobha)*; the ants being affected by this heat earlier than the atmospheric movements which bring the clouds and the rain.

SYNCHRONOUSNESS OF CAUSE AND EFFECT

This is resolved into a case of simultaneous co-effects of the same ultimate cause, e.g. the ascent of one scale and the descent of the other in the balance, which are not related as cause and effect, but are simultaneous effects of gravity. In other cases the synchronousness is only apparent, the interval between the antecedent and the consequent being too small *(sūkṣma-kāla)* to be apprehended e.g. in the case of the needle piercing a hun-

dred soft lotus-petals laid one upon another, where the steps are really successive; or the illumination of the whole room by the light of a lamp, where the succession is unperceived owing to the inconceivable velocity of light (cf. Kumārila, *Śloka-vārtika*, Sūnya-vāda, *Śloka* 156-157. I quote Mimāṃsā authorities, but the view is common to the Mīmāṃsā and the Nyāya-Vaiśeṣika).

THE TIME-RELATION IN A CHAIN OF CAUSES AND EFFECTS

A careful study of the time-relation in a chain of causes and effects is a peculiarity of the Vaiśeṣika system (and the later Nyāya). A moment (ultimate unit of time, *kṣaṇa)* is defined to be the time-interval between the completion of the sum of conditions and the appearance of the effect. The Vaiśeṣika conceives the unit to be determined by reference to the division of one atom from another *(Sapta-padārthī,* Śivāditya : the ultimate unit of time is the time during which motion exists in an atom prior to its division from another atom, in a case of division due to motion). The Sāṃkhya, we have already seen, determines this ultimate unit by reference to the motion of a *tanmātra.*

The number of such units will determine the time-interval between a given set of physical conditions and a particular effect, for between a so-called sum of causes and a so-called sum of effects there intervenes a series of atomic (or molecular) motions, with conjunctions and disjunctions which form the causal chain. However crude in the practical application, the fundamental idea is, in connection with the principle of work and energy (for which both the Sāṃkhya and the Nyāya-Vaiśeṣika furnish a rudimentary basis), immensely suggestive of a possible Time Calculus.

THE NYĀYA GROUND OF INFERENCE—VYĀPTI

Inference, then, in the Nyāya, depends on the ascertainment, not of the causal relation, nor of the relation of genus to

species, but of a natural relation, between two phenomena, of invariable and unconditional concomitance (Uddotakara and Vācaspati). Of the two phenomena so connected, one is called the *vyāpya* or *gamaka* (the sign, mark, or indicator), and the other *vyāpaka* or *gamya* (the thing signified, marked, or indicatted). In the relation of fire and smoke, for example, smoke is the *vyāpya* or *gamaka* (sign or mark) ; and fire, the *vyāpaka* or *gamya* (the thing signified or marked). Now the relation of *vyāpti* between *A* and *B* may be either unequal or equipollent *(viṣama* or *sama)*. When *A* is the sign of *B*, but *B* is not the sign of *A*, the *vyāpti* is one-sided or unequal, and here a *vyāpti* is said to exist, between *A* and *B*, but not between *B* and *A*. For example, smoke is a sign of fire, but fire is not universally a sign of smoke. When, therefore, the relation of *vyāpti* is an unequal one, as between smoke and fire, it is expressed in the proposition : "Wherever the *vyāpya* (sign or mark, e.g. smoke) exists, the *vyāpaka* (the thing signified or marked, e.g. fire) also exists." From this it follows by necessary implication (a sort of *arthāpatti*) that whenever the *vyāpaka* (e.g. fire) is absent, the *vyāpya* (e.g. smoke) is also absent. Again, the *vyāpti* may be a mutual or equipollent one, i.e. *A* and *B* may be signs of each other, e.g. green-wood fire and smoke. Here each in turn is *vyāpya* and *vyāpaka*, and this is expressed in the two propositions : (1) Wherever there is smoke there is green-wood fire, and (2) wherever there is green-wood fire there is smoke. By necessary implication it follows : (1) Where there is no green-wood fire there is no smoke and (2) where there is no smoke there is no green-wood fire. We have seen that a *vyāpti* exists between smoke and fire, for wherever there is smoke there is fire, but we cannot say that a *vyāpti* exists between fire and smoke, for we cannot say that wherever there is a fire there is smoke. The combustion of an iron ball *(ayogolaka)*, for example, is a case of fire without smoke. But it would be correct to say that a *vyāpti* exists between green-wood fire and smoke, as well as between smoke and green-wood fire. The question, therefore, is : what is the relation between fire and smoke ? The relation between fire and smoke is a conditional relation; i.e.

on condition that the fire is green-wood fire, it would be a sign of smoke. In other words, a *vyāpti* implies unconditional invariable concomitance, and the relation between fire and smoke is not therefore a *vyāpti* (natural unconditional concomitance), for fire requires a "condition", *upādhi*, viz. green-wood, to be followed by smoke. Smoke, on the other hand, requires no "condition" to indicate fire. For the purposes of Inference, therefore, relations between phenomena may be considered as of two kinds : (1) Contingent conditional relations, holding good on the fulfilment of a certain condition or *upādhi*, and (2) *vyāpti*, or unconditional invariable relation, between a mark and that which it marks, a relation without any *upādhi* or determining condition. It is this latter kind of relation that serves as the ground of inference. If we can ascertain that a *vyāpti* exists between *A* and *B*, then *A* is a sign of *B*, and an inference of the presence of *B* from the presence of *A*, and of the absence of *A* from the absence of *B*, would be warranted. The question, therefore, is how to ascertain the relation of *vyāpti* between two phenomena ?

ASCERTAINMENT OF VYĀPTI ACCORDING TO THE EARLY NYĀYA

Briefly speaking, the observation of agreement in presence *(anvaya)* as well as agreement in absence *(vyatireka)* between two phenomena, with the non-observation of the contrary, is the foundation of our knowledge of *vyāpli*. This suggests a natural relation of invariable concomitance between the phenomena, which is fortified by our non-observation *(adarśana)* of the contrary *(vyabhicāra)*. But this does not establish the unconditionality of the concomitance, which is essential to a *vyāpti*. We have therefore to examine the cases carefully to see if there is any determining condition (*upādhi*—i.e. some hidden or undetected but really operative or indispensable accompaniment) which conditions the relation between the supposed sign or mark *(gamaka)* and the supposed signate (thing signified, *gamya)*.

Now let us consider what constitutes an *upādhi*. It is a circumstance which always accompanies, and is always accompanied by, the supposed signate (the thing signified, *gamya)*, but does not invariably accompany the supposed sign or mark *(gamaka)*. If, therefore, in the set of positive instances where both the sign and the signate are present, nothing else is constantly present, there can be no *upādhi*. Or, again, if in the set, of negative instances where both the sign and signate are absent, no other material circumstance is constantly absent, there is no *upādhi*. This follows from the very definition of an *upādhi*. It is impracticable to fulfil these requirements rigorously. Still, every one of the accompanying circumstances (of course the likely ones) may be taken successively, and it may be shown that the concomitance continues even when the suspected *upādhi (śaṅkitopādhi)* is absent, and therefore it cannot be the *upādhi*. And this is to be fortified by the observation of uniform and uninterrupted agreement in absence *(vyatireka)* between the two concomitant phenomena. In this way, when we have disproved all suspected *upādhi*-s, we conclude by establishing the *vyāpti*. It is true that we may still go on doubting ; but doubt has a certain limit for the "experimenter" and the thinking person.

When doubt overthrows the foundation of all rational practice or leads to a stoppage or arrest of all practical activity *(loka-vyavahāra)*, it stands *ipso facto* condemned, and must be abandoned. Thus it is that *vyāpti* is ascertained. In this way we observe innumerable instances of *vyāpti*. Now, by means of repeated observations of this kind *(bhūyo-darśana)* we have established the principle of the Uniformity of Nature, and also of Causality; and these two principles thus ascertained may be made use of in their turn as the basis of an argumentation or deduction *(tarka, ūha)* to confirm a particular *vyāpti* in a particular case. *Tarka* or *ūha*, then, is the verification and vindication of particular inductions by the application of the general principles of Uniformity of Nature and of Causality,

principles which are themselves based on repeated observation and the ascertainment of innumerable particular inductions of uniformity or causality. Thus *tarka* also helps in dispelling doubt *(sandeha)*. Śrīharṣa, however, questions the validity of this verification—cf. the well-known couplet ending *tarkaḥ śaṅkāvadhiḥ kutaḥ*.

It will be seen that the process of disproving all suspected *upādhi*-s, in the early Nyāya, answers exactly *as a process* to Mill's Method of Agreement. In fact, the disproof of a suspected *upādhi* by pointing to instances of agreement in presence, even in the absence of the *upādhi*, fortified as this is by the instances of agreement in absence, virtually amounts to Mill's Joint Method of Agreement. But the fundamental difference is this : Mill's Method of Agreement is formulated in view of the phenomena of causation (including co-effects, etc.), and, as usually enunciated, confessedly breaks down in dealing with cases of Uniformities of Co-existence unconnected with Causation; the Nyāya Method, based on the disproof of suspected *upādhi*-s, is a more daring and original attempt, and is far more comprehensive in scope, being applicable to all Uniformities of Co-existence and of Causation alike. And this the Nyāya successively accomplished by introducing the mark of unconditionality into the relation of *vyāpti* (Concomitance), even as the same mark of unconditionality had been previously introduced into the definition of Causality. The difference between the early Nyāya and the Buddhist systems may be briefly put thus : The former relied on empirical induction based on uniform and uninterrupted agreement in Nature, and accordingly regarded the Method of Agreement as the foundamental Method of Scientific Induction, founding Inference on *vyāpti*, to which they subordinated Causality in the doctrine of Method; the latter assumed two *a priori* principles, viz. causality and identity of essence, deduced the canon of the Method of Difference by an indirect proof from the principle of Causality, and made this Method the foundation of all scientific Induction of Causality, just as they based all natural classification of genera and species on their *a priori* principle of Identity of Essence.

VYĀPTI BETWEEN CAUSE AND EFFECT—RELATION OF CAUSALITY TO VYĀPTI.

On the Buddhist (and early Nyāya) view that one specific assemblage of "effect" phenomena has one specific assemblage of causal conditions, there would be two aggregates—the sum of causal conditions *(kāraṇa-sāmagrī)* and the sum of effects *(kārya-sāmagrī)*. For example, fire requires green-wood to complete the sum of causal condidions to give rise to smoke with some particular mark. Here, between an effect and a single condition (termed a cause) there is a relation of *vyāpti*. The effect is *vyāpya* or *gamaka* (the sign or mark); the cause (or condition) is *vyāpaka* or *gamya* (the thing signified). In other words, the presence of the effect indicates the presence of the causal conditon, and the absence of the causal condition will by implication indicate the absence of the effect. Smoke of this particular kind is supposed to be an effect of which there is one and only one assemblage of causal conditions (fire and green-wood); hence, where there is smoke there is fire, and when there is no fire, there is no smoke.

Now introduce the complication of the plurality of causes. Fire, for example, is the effect of several assemblages, e.g. (1) blowing on heated grass; (2) focussing rays through a lens on a combustible like paper or straw; (3) friction with the fire-drill, etc. Here each assemblage is regarded as a sum of causes. But in this case there is no *vyāpti* between the effect "fire" and any particular assemblage of causal conditions, say of the lens or the fire-drill; for the presence of fire does not indicate the presence of the lens or the fire-drill assemblage, nor does the absence of either of the latter in particular indicate the absence of fire. Indeed, in such a case the effect "fire" is not a mark or sign *(gamaka* or *vyāpya)* of any one in particular of the different possible causal assemblages, though each of these particular assemblages of causal conditions is a mark or sign *(gamaka* or *vyāpya)* of fire.

The plurality of causes requires a further consideration in the light of the definition of the causal relation. A cause is defined to be the unconditional invariable antecedent. From

the unconditionality it follows that the entire sum of conditions, and not one single condition, is, properly speaking, the cause. In view of the plurality of causes, an invariable antecedent must be taken to mean that any particular cause (i. e. assemblage of causal conditions) is invariably followed by the effect—not that the effect is invariably preceded by any particular cause.

Popularly, a single condition, say the lens or the fire-drill, is said to be a cause of fire; but, in view of the plurality of causes, this is apt to be misleading, as there is no *vyāpti* in this case; the lens or the fire-drill is no more a mark of fire than fire is a mark of the lens or the fire-drill.

The plurality of causes strains the definition of a cause, and undermines the relation of *vyāpti* between an effect and a cause. Any particular cause (causal aggregate) still indicates the effect, but not *vice versa*. The earlier Nyāya (down to Vācaspati and Jayanta) obviated the plurality, as we have seen, by introducing distinctive marks in the effect such as would indicate a single specific cause *(kārya-bheda* indicating *kāraṇa-bheda)*. Some, indeed, went farther and held that when the antecedent causal assemblages differ in kind, the effect-phenomena, though apparently the same, do really differ specifically (or in kind). But the Nyāya discards this hypothesis; the fire is the same, though the possible causes (or causal aggregates) differ, e.g. the lens, the drill, etc. But the effect-phenomenon to which we attend is not the only effect; in the case of plurality of causes we must carefully examine the accompaniments of the effect, i. e. the sum of effects, and the examination will show some distinctive or specific circumstance or accompaniment which will enable us to definitely determine the particular assemblage of causal conditions that must have preceded in the case under examination. This is the device of the earlier Nyāya as well as of the Buddhists, as we have seen; but the later Nyāya doubts the practicability as well as the theoretical validity of such a step on an unrestricted assumption of the plurality of causes, and feels troubled by the circumstance that no effect for which more than one cause (or causal aggregate) can be assigned, can be

regarded as a mark or sign *(gamaka* or *vyāpya)* of any one of the causes in particular. Accordingly, some adherents of the later Nyāya advanced the proposition that when more than one causal aggregate can be supposed for any effect, the latter is a mark or sign *(gamaka* or *vyāpya)* not of any one of the causal aggregates in particular, but of one or other of them; and the absence not of one such cause, but of each and every one of them, alone indicates the absence of the effect. A cause therefore should be defined to mean *one or other* of the possible alternative aggregates which, being given, the effect follows invariably and unconditionally. If we ask what is the defining mark (or quiddity) of the cause *(kāraṇatāvacchedaka)*, we are told that it is *one-or-otherness (anyatamatva)*, and nothing else; others cut the Gordian knot by assuming that the different possible causes of the same effect possess a common power or efficiency, or common "form", which accounts for the production of a common effect. The latter is therefore a sign or mark of this power or this form which is manifested by each of the causal aggregates. This hypothesis, they hold, is simpler and more plausible than the hypothesis of specific differences latent in the apparently identical effect of a plurality of causes.

The scientific Methods already noticed—the Joint Method of Difference (the *pañcakāraṇī)* and the Joint Method of Agreement *(vyāptigraha* with *upādhiśaṅkānirāsa* and *tarka)*—are not the only methods of ascertaining causality or concomitance, or establishing a theory; nor are these Methods always practicable. Very often we reach the explanation of a fact *(upapatti)* by means of a hypothesis *(kalpanā)* properly tested and verified *(nirṇīta)*. A legitimate hypothesis must satisfy the following conditions : (1) the hypothesis must explain the facts; (2) the hypothesis must not be in conflict with any observed facts or established generalisations; (3) no unobserved agent must be assumed where it is possible to explain the facts satisfactorily by observed agencies; (4) when two rival hypotheses are in the field, a crucial fact or test *(vinigamaka, ratio sufficiens)* is necessary; the absence of such a test is fatal to the establishment of either; (5) of two rival hypotheses, the simpler, i. e.

that which assumes less, is to be preferred, *ceteris paribus*; (6) of two rival hypotheses, that which is immediate or relevant to the subject-matter is to be preferred to that which is alien or remote; (7) a hypothesis that satisfies the above conditions must be capable of *verification (nirṇaya)* before it can be established as a theory *(siddhānta)*. The process of verification of a hypothesis consists in showing that it can be deduced as a corollary from (or is involved by implication in) some more general proposition which is already well established (cf. Vātsyāyana's exposition and illustration of Verification, *nirṇaya*—inculding both the Deductive Method and Colligation).

This doctrine of Scientific Method, in Hindu logic, is only a subsidiary discipline, being comprehended under the wider conception of Methodology, which aims at the ascertainment of Truth, whether scientific *(vijñāna)* or philosophical *(jñāna)*; the latter being the ulterior aim. In the investigation of any subject, Hindu Methodology adopts the following procedure : (1) the proposition (or enumeration) of the subject-matter *(uddeśa)*, (2) the ascertainment of the essential characters or marks, by Perception, Inference, the Inductive Methods, etc.—resulting in definitions (by *lakṣaṇa)* or descriptions (by *upalakṣaṇa)*; and (3) examination and verification *(parīkṣā* and *nirṇaya)*. Ordinarily the first step, *uddeśa*, is held to include not mere Enumeration of topics, but Classification or Division proper; but a few recognise the latter as a separate procedure coming after Definition or Description. Any truth established by this three-fold (or four-fold) procedure is called a *siddhānta* (an established theory). Now the various *pramāṇas*, Proofs, i.e. sources of valid knowledge, in Hindu logic, viz. Perception, Inference, Testimony, Mathematical Reasoning *(sambhava*, including Probability in one view), are only operations subsidiary to the ascertainment of Truth *(tattvanirṇaya)*. And the Scientific Methods are merely ancillary to these *pramāṇa*-s themselves.

I have explained the principles of the Hindu doctrine of Scientific Method, avoiding the technicalities of Logic as far as possible; and I cannot here enter upon the logical terminology or the logical apparatus and machinery, which would require

a separate volume to themselves. For these I would refer the reader to my paper on *Hindu Logic* as also for an account of the later Nyāya *(Navya-nyāya)*. I will conclude with a few observations on Applied logic, i.e. the logic of the special sciences, which is such a characteristic feature of Hindu scientific investigation. What is characteristic of the Hindu scientific mind is that, without being content with the general concepts of Science and a general Methodology, it elaborated the fundamental categories and concepts of such of the special sciences as it cultivated with assiduity, and systematically adapted the general principles of Scientific Method to the requirements of the subject-matter in each case. The most signal example of applied logic (or Scientific Method) worked out with systematic carefulness is the Logic of Therapeutics in Caraka, a Logic which adapts the general concepts of cause, effect, energy, operation, etc., and the general methodology of science, to the special problems presented in the study of diseases, their causes, symptoms, and remedies (see *Caraka,* Vimānasthāna, Chap. IV.; also Sūtrasthāna; *vide* my paper on *Hindu Logic.)*

CAUSALITY AS *WELTANSCHAUUNG* : EARLY BUDDHISM

T. W. RHYS DAVIDS

The doctrine of *paṭicca-samuppāda*—that all *dhammā* (phenomena physical and mental) are *paṭicca-samuppannā* (happen by way of cause) finds in the *Mahā-nidāna-suttanta* or "The Great Discourse on Causation" the fullest exposition accorded to it throughout the Piṭakas. It is true that for some reason the records of the *Dīgha-nikāya* excluded the first two of the twelve *nidāna*-s (causes)—*avijjā, sankhārā*—and that in the *Paccayākāra-vibhanga* of the Abhidhamma, the formula is reiterated and analysed with greater variety of presentation. But in the *Mahā-nidāna-suttanta* the doctrinal contents are more fully worked out. There is another feature in this Dīgha exposition which seems to us of no little significance.

But before discussing this feature, we would point to yet another factor in the statement in the chain of *nidāna*-s which does not find a place in the *Nidāna-suttanta.* This is the schematised or abstract formula of the whole sequence, showing the logic of it without the contents : "That being thus, this comes to be; from the coming to be of that, this arises. That being absent, this does not happen ; from the cessation of that, this ceases." In the other *nikāya*-s, this scheme usually precedes the full formula, and in one case where the principle of the latter is called the *dhamma, supersedes* the formula. It is on all fours with the modern formulation of the law of causation—"That every event is the result or sequel of some previous event, or events, without which it could not have happened, and which, being present, it must take place."

The significant feature is this : although the formula, as expounded in the *Nidāna-suttanta,* ends in the usual way—"Such is the uprising of this whole body of ill"—the burden of the dialogue is in no way directly concerned with "ill", pain or sorrow.... That any being exists absolutely and eternally is at the same time denied.... Once more in the very strongly

emphasised rehearsal of the formula in the *Great Tāṇhā-sankhaya-sutta*, the doctrine there inculcated is not in any way hedonistic, sentimental or, directly, moral. It has nothing to say about *dukkha*. It is a repudiation of the belief in any permanent, transmigrating intelligent principle in man, and the affirmation of the contrary view that *viññāṇa* (intelligent principle) is a contingent phenomenon, a happening by way of cause and effect, something that *becomes* and dies away. *Dukkha*, on the other hand, and the causes of it—*evam…samudayo*—holds, in nearly every case, the last word in this notable formula. And according to the Buddhist records, as told in the *Mahāpadāna-suttanta*, the fact and sequence of those causes dawn ever on the mind of every Buddha in response to the anguished questionings of his mind brooding over the misery of the world, and of the infinite living and dying in it.

Hence in trying to account adequately for the profound significance and high importance attached by the founders of Buddhism to the doctrine of the *paṭicca-samuppāda*, we need to keep in view this dual aspect of it—that it is a way of explaining phenomena, and that the most interesting phenomenon to be explained is that of *dukkha*. The latter standpoint is that of men as recipient or percipient, the former, that of man as intellective or interpreting.

Now if to this twofold aspect we add that of man as reacting, by will and deed, to his impressions and his interpretations, and take the Buddha's doctrine of the Eightfold Path, as the corresponding formula, we have not only the whole of Early Buddhism in a nutshell, but also just those points concerning which we find the most emphatic affirmations of *dhamma* as *dhamma* ascribed to Gotama :

> "Both in the past and now do I set forth *just this* : *dukkha* and the cessation of *dukkha*."

> "Let us put aside questions of the Beginning and the End.

> I will teach you the *dhamma* : That being thus, this comes to be. From the coming to be of that, this arises. That being absent, this does not happen. From the cessation of that, this ceases."

> "There is a Middle Path...discovered by the Tathāgata (discovered by none but a Tathāgata)...This Aryan Eightfold Path"...

These three central tenets are put, by our earliest and best authorities, in these or other words, in the mouth of Gotama himself at the very outset of his career, in his first sermon, as the doctrine of the Four Aryan or Noble Truths. And the *paṭicca-samuppāda,* with its positive formula of uprising *(samudaya)*, and its negative formula of passing away *(nirodha)*, covers the ground staked out by the second and third of these Truths. It is frequently quoted in this connection, and its importance in the *dhamma* is thereby made the more evident.

But the reason for that importance only becomes clear when we look away from the *dukkha* to which the formula is so often applied, away too from the antecedence of *dukkha,* and consider all that is implied in the *paṭicca-samuppāda* by way of method and *Weltanschauung.* If we persist in viewing either *dukkha* or its causes as the 'secret' of the doctrine, we might omit the formula altogether, since the nature and cause and effect of each *nidāna* is fully taught in each *nikāya.* Nor is the order of sequence the main tenet. Frequent liberties are taken in the Canon with both order and number of *nidāna*-s. Nor finally could the arrangement of antecedents and consequences in an iterated rigmarole (convenient for oral transmission) appeal with the runic force of a Shibboleth to a movement of thought like that of Buddhism, any more than would be similarly arranged fragment of formula contained in the *Sāṅkhya-kārikā* have appealed, as such, to the followers of that school. No reformers who so carefully purged their literature of all the 'eulalic' reiterations of "*Om* ! *Hari* !" and the rest, that so throng the pages of the Upaniṣads would care a brass farthing for any 'accumulative jingle' accounting

for things after the fashion of the widely spread pre-historic folk rune...

It was not the fact of *dukkha* nor the fairly obvious conditions of birth and so on leading up to it, that come as a revelation to each Buddha, beneath his Bo-tree. It was the process of *samudaya* and *nirodha* as a natural and universal law.

> Coming to pass : Coming to pass : At that thought there arose in me a Vision into things not called before to mind, and knowledge arose, insight, wisdom, light arose.

Not uncaused and casually, nor by the fiat of Īśvara—Indra, Soma, Varuṇa, Brahmā—did events happen, painful or otherwise; not as Job and the Psalmist taught—"God distributeth sorrows in his anger" (*Job* xxi. 17). For "God is a righteous judge and God is angry with the wicked every day" (*Psalm* viii. 7.2). Events come impelled by preceding conditions, causes that man could by intelligence and good will study and govern, suspend or intensify.

Thus Buddhaghoṣa, in explaining the name *paṭicca-samuppāda*, points out that it *excludes* all theories of absolutism, nihilism, chance, irregular causation, and indeterminism. And of such theories, it is concerning the implied rejection of the first two that he is most explicit. Mainly, that there is no persistent ego reaping results in one life sown as causes in a previous life, and that it is not a different, and alien ego either, which reaps. The latter person (*attabhāva*) is the resultant, the creature, the 'evolute' of the former. Thus faithfully was the tradition of the Piṭaka-s preserved, wherein the view of *viññāṇa* as a persistent ego was categorically contradicted in the words *aneka-pariyāyena paṭicca-samuppanna* (causally evolved in various ways).

Let it be remembered that the "immanent" absolutism opposed by Buddhism was chiefly the Brahmanic theosophy. According to this, the *ātman* of the individual was not so much an efflux of the World-Ātman, as was the latter immanent in, and identified with, each man-soul. "In the beginning this world was only Soul, in the shape of a man... world-guardian, world-lord, this i.e. My Soul." (*Bṛ Up* i.4.1; *Kauś Up* iii.8). "My Soul"

was therefore, in that theosophy, the personal First Cause and Final Cause. And hence the *paṭicca-samuppāda* of Buddhism was as decided a negation of all teleology as was the theorem of Demokritus and his master Leukippus, that "nothing happens by chance, but everything through a cause and of necessity."

Had the fates been kinder to the writings of the Atomist of Abdera, had the "teleological reaction" not been led by two men of such extraordinary genius as Plato and Aristotle, it is conceivable that the whole philosophy, not to say the *dhamma,* of the West, might have flowed along a channel in which the influence of the *mikros* and the *megas Diakosmos* might have brought both that philosophy and that *dhamma* more nearly parallel to the informing principle of the *paṭicca-samuppāda.* As it happened, Europe learned from Athens compromise and comprehensiveness, learned to believe in a universe governed partly by necessity and partly by chance, learned to combine belief in unchanging natural law with belief in First and Final Causes.

And so gradually has the realm of regular, causal sequence encroached upon that of the casual and the arbitrary, that on no period in the intellectual development of Europe can we place our finger and say : Here the concept of a universe governed, as to its every movement and happening, by natural causation, was brought home to the minds of men,—to the mind of one man. There is nothing resembling the intellectual earthquake caused half a century ago by that extension of the law of causation : the theory of evolution. Or was there some such milestone of rational development reached, when Demokritus formulated the philosophy of Atomism,and won renown as a great prophet and teacher of mankind ?

In the history of Indian thought, on the other hand, we can point to such an epoch-making crisis, we can discern the significance of the law of universal causation breaking in on a great mind with a flash of intuition. The law, we read, stands as fundamental, whether Tathāgatas have arisen or not. But the Tathāgata penetrates and masters it, and delivers the knowledge thereof to the world.

No such crisis of thought is patent in the literature of the Brahmins, though that literature extends over practically the whole era of Indian culture. Those Upaniṣads which are ranked as the oldest show a naif animism : those ranked later reveal thought attained to relative maturity. But there is no evidence of a transition causing a mental upheaval. In the 72 stanzas of the *Sāṅkhya-kārikā*, again, 25 *per cent* contain some consciously generalised affirmation respecting cause and effect. The abstract causal concept shows as a well-matured instrument of metaphysical thought. Throughout the *Yoga-sūtra,* too, we find allusions to causality as an abstract idea. It is only in the Buddhist *nikāya*-s that we come up against the actual effort itself of the human mind to get at a more scientific view of world-order,—an effort which is marked with the freshness and vigour of a new fetch of intellectual expansion, and the importance and gravity of which is affirmed with the utmost emphasis, both in the earliest records and in the orthodox literature of ten centuries later.

The significance of the Piṭaka-s as the vehicle of this evolutionary cry of travail and new birth, is not minimised by the objection, that a Gospel promulgated by laymen (Khattiyas), and preached to the man in the street, would naturally regard as truths new and wonderful, axioms which, to the more esoteric, philosophical schools of the day, were the commonplaces of dialectical metaphysic. For we have shown that, in the one case where such a school has preserved its ancient literature, we find books of pre-causational and post-causational thought, but nothing indicating that the conviction of universal natural causation was taking birth...

Now in the history of philosophy, whether its concepts be sought in the cell and the academy of the originating seer, or in the reaction to his influence in thoughtful and earnest minds, nothing is more illuminating either for chronology or for interpretation, than to catch the intelligence in the act of ascending to a fresh vantage-point in its interpretation of the world :

Dhammamayaṃ, Sumedha, pāsādaṃ āruyha, samantacakkhu... avekkhassu !

And since no auspicious day amid Egyptian or trans-Agean ruins has brought back to us Leukippus or Demokritus, the Buddhist Piṭaka-s, by presenting this evolutionary moment, causes a unique interest for the historian of human ideas, not only in India, but in the entire world of culture.

MEDICINE

ON THE MEDICAL AUTHORITIES

G. N. MUKHOPADHYAY

AGNIVEŚA

Agniveśa is said to have been the son of Agni, the god of fire. Bharadvāja gave him the Āgneyāstra or "the weapon of fire" which Agniveśa in his turn presented to Droṇācārya, the preceptor of the Pāṇḍavas (Dawson, *Classical Mythology*, p. 6). Pāṇini wrote an aphorism for Garga, Agniveśa and others *(Pāṇini*, 4.1.105*)*. He was the most intelligent amongst the disciples of Ātreya Punarvasu. He was of sharp intellect, and his work was declared to be the best of all the books composed by the pupils of Ātreya. *(Caraka-saṃhitā*, i.1*)*. His work was called *Agniveśa-tantra* and this was afterwards redacted by Caraka, and so became known as the *Caraka-saṃhitā*.

Dr. Ray maintains that the work of Agniveśa became obsolete when Vāgbhaṭa wrote his *Aṣṭāṅga-hṛdaya-saṃhitā* (see *History of Hindu Chemistry*, p. xiii); but this is not true, for Vāgbhaṭa distinctly mentions Agniveśa to be one of his sources *(Aṣṭāṅga-hṛdaya-saṃhitā*, I.i). Similarly Vāgbhaṭa I, also in his *Aṣṭāṅga-saṃgraha* cites Agniveśa's book as one of his sources *(Aṣṭāṅga-saṃgraha*, vi. 1). Indu in his commentary *Śaśilekhā* writes : *mayā ca agniveśādi-kṛta* etc. *(Śaśilekhā*, vi. 1*)*. In the *Suśruta-saṃhitā*, vi.i, we read : *...ye coktāḥ paramarṣibhiḥ*. Ḍalvaṇācārya comments on it as follows : *ṣaṭsu kāyacikitsāsu agniveśa-bheda*...etc.

This shows that when the old *Sauśruta-tantra* was redacted by Nāgārjuna and became known as the *Suśruta-saṃhitā*, Agniveśa's work was extant. Śrīkaṇṭhadatta (1288 A.D.), the disciple of Vijaya Rakṣita (1240 A.D.) and the commentator of Vṛnda's *Siddhayoga* (in his *Vyākhyā-kusumāvalī)* cites *ślokas* from *Agniveśa-tantra* which are not found in the *Caraka-saṃhitā (vide* Śrīkaṇṭha's comment on the use of sand-bath in fever). Bhā-

vamiśra also quotes in his *Bhāva-prakāśa* passages from *Mādhava-nidāna* and *Vyākhyā-madhu-kośa* in which Agniveśa is referred to. The book appears to have existed in the time of Cakrapāṇi Datta (1060 A.D.), the famous commentator of *Caraka-saṃhitā*.

The book is not available now; but the nature of his work can however be known from the quotations in different works.

Agniveśa was also known by the name of Hutāśa; and by this name he is quoted by Mādhavakara in his *Nidāna* in the chapter on "Fracture : Its Pathology" thus : *bhagnaṃ samāsād dvividhaṃ hutāśa*. Śrīkaṇṭhadatta in *Vyākhyā-madhu-kośa* comments : *carake hutāśa-śabdenāgniveśaḥ* etc. (p 248). Bhāvamiśra quotes both the Mādhava's reading and Śrīkaṇṭha's comment on it in his *Bhāva-prakāśa*.

The following formulae are attributed to Agniveśa : 1. Cāṅgerī Ghṛta, 2. Vāsādyāṃ Ghṛta, 3. Ṣaṭpalaṃ Ghṛta, 4. Cavyādyaṃ Ghṛta, 5. Śvādaṃṣṭrādyaṃ Ghṛta, 6. Tiktakaṃ Ghṛta, 7. Mahātiktakaṃ Ghṛta, 8. Tryūṣuṇādyaṃ Ghṛta.

BHELA

Bhela was one of the six disciples of Punarvasu Ātreya and, like Agniveśa and others, he wrote a treatise on Medicine—*Bhela-saṃhitā*—from which Vāgbhaṭa II acknowledges to have derived help (*Aṣṭāṅga-hṛdaya-saṃhitā*, I. i. p. 7). When Vāgbhaṭa II flourished, *Caraka-* and *Suśruta-saṃhitā* had already undergone redaction but *Bhela-saṃhitā* was available in its original form. This fact becomes clear, from his reference to *Bhela-saṃhitā* being the work of a Ṛṣi, whereas the *Caraka-saṃhitā* and *Suśruta-saṃhitā* contained redactions of later authors (*Aṣṭāṅga-hṛdaya-saṃhitā*, VI. xl. p. 405).

Burnell thinks that Bhela was a native of Gāndhāra or Kandahara from the repeated mention of the country in his book.

Bhela is also known as Bheḍa, and as such he is mentioned in the works of Vāgbhaṭa, the commentator Ḍallaṇa and others.

Bhela-saṃhitā : The book in a mutilated state is noticed in

Burnell's *Tanjore Catalogue of Sanskrit Manuscripts*, p. 63 ff, (No. 10773). The manuscript is dated about 1650 A.D. The general outline of the treatise of Bhela agrees with that of Caraka. Burnell mentions Nidāna, Vimāna, Śārīra, Indriya, Cikitsita and Kalpa Sthāna-s. But in commenting on a formula of Bhela in *Vṛnda-mādhava*, Cakradatta, Śrīkaṇṭha Datta and Śivadāsa say : *bhāluki-tantroktatvādasya* etc.

Thus we know that there was a Siddhi-sthāna in the *Bhela-tantra*. But we are not sure that Bhela and Bhāluki were identical persons. *Bhela-tantra* has been quoted by Ḍallaṇa, Vijaya Rakṣita, Śrīkaṇṭha Datta, Śivadāsa, Cakrapāṇi Datta and Vṛnda Mādhava. Bhāluki Vaidyaka is qouted in *Ātaṅka-nigraha* and *Bhāluki-cikitsā* in the *Todarānanda*.

Many think that *Bhela-saṃhitā* and *Bhāluki-saṃhitā* or *-tantra* refer to the same work. But as Ḍallaṇācārya in the *Nibandha-saṃgraha* mentions both Bhela and Bhāluki in the same sentence, they were possibly different individuals.... The quotations from *Bhāluki-tantra* deal mainly with surgery, and so possibly Bhāluki was a surgeon. Cakrapāṇi refers to Bhāluki in his description of the surgical instruments.

Manuscripts of Bhela-saṃhitā : So far as known at present only one manuscript of the book is known to exist. Hoernle possessed a copy of it in Telegu made for him by Order of the Government of Madras in 1905; Cordier had two copies, one in Telegu and the other in Devanāgarī at an earlier date (See his *Recents Decouvertes*, pp. 4-5). Another manuscript "*Radh* 32" is mentioned in Aufrecht's *Catalogus Catalogorum* 416 as existing in a native library in Lahore. But we have not been able to know anything of this manuscript. Sir A. T. Mookerjee had two copies of the manuscript in Telegu; and it has been published in the Devanāgarī character by the University of Calcutta in the *Journal of the Department of Letters*, Vol. VI, in 1921.

Formulae attributed to *Bhela* and *Bhāluki* : 1. Sahācara oil, 2. Bhela's Formula, 3. Bhāluki's Formula, 4. Nīla butter, 5. Mahānīla butter, 6. Dhavantari butter, 7. Guggulu Tiktaka, 8. Bhelī *yavāgū* or the Gruel of Bhela, 9. Bhāluki's Mantra.

JATUKARṆA

Jatukarṇa was one of the six disciples of Punarvasu Ātreya. In some manuscripts the name is also spelt as Jātūkarṇa. Like Agniveśa, he wrote a book on medicine known as *Jatukarṇa-saṃhitā* (or *tantra*). The book is not available now.

Jatukarṇa is quoted in Śivadāsa's commentary *Tattva-candrikā*, Vijaya Rakṣita and Śrīkaṇṭha Datta's commentary *Vyākhyā-madhu-kośa* and *Vyākhyā-kusumāvalī*; and in the *Nibandha-saṃgraha* by Dallaṇācārya.

The following formula is attributed to Jatukarṇa : Mahātiktaka Ghṛta.

HĀRĪTA I

Hārīta was one of the six disciples of Punarvasu Ātreya. He also wrote a treatise on medicine called *Hārīta-saṃhitā*. Some consider that *Hārīta-saṃhitā* and *Atreya-saṃhitā* are identical books. But Bhāva Miśra quotes passages from *Ātreya-saṃhitā* which are not to be found in the *Hārīta-saṃhitā*. The *Hārīta-saṃhitā* is not available now; but a more modern compilation has been printed in Calcutta as the original treatise. The author of the book—Pseudo-Hārīta—is decidedly posterior to Vāgbhaṭa I, whom he mentions as an authority for Kaliyuga. The arguments against the printed edition being called the *Hārīta-saṃhitā* will be discussed in detail under Pseudo-Hārīta or Hārīta II. The ancient author is described as Vṛddha Hārīta or Hārīta I.

Hārīta is also quoted in the *Bheṣajakalpa-saṃgraha* (Ms. G. O.M.L. 13183) and Vṛddha Hārīta in the *Todarānanda*.

Formulae ascribed to *Hārīta* (all Butter) : 1. Kaṭuka, 2. Mahāvāsādya, 3. Daśāṅga, 4. Laśuna, 5. Nārācaka, 6. Mahāṣaṭpala, 7. Āvartakī, 8. Drākṣādya, 9. Dvipañcamūlādya, 10. Drākṣādya, 11. Mahā Nīla, 12. Kacchu Rākṣasa (oil).

KṢĀRAPĀṆI

Kṣārapāṇi was also one of the six disciples of Punarvasu

Ātreya. He was the author of a medical treatise—the *Kṣāra-pāṇi-tantra.* He is quoted by Śrīkaṇṭha Datta in *Vyākhyā-madhu-kośa* and *Vyākhyā-kusumāvalī,* by Śivadāsa in *Tattva-candrikā* and by Candrāṭa in *Cikitsā-kalikāvivṛti* and by Cakrapāṇi Datta in *Tattva-candrikā* and *Carakatattva-pradīpikā, Āyurveda-dīpikā.*

Perhaps he was identical with the ancient author Kṣīrapāṇi.

VṚDDHA PARĀŚARA OR PARĀŚARA I

Vṛddha Parāśara or Parāśara the Elder was a son of the sage Śakti and grandson of Vasiṣṭha Ṛṣi. Adṛśyantī was his mother. He married Satyavatī and was the father of Vyāsa (*Agni-purāṇa*).

He learned *Viṣṇu-purāṇa* from Pulastya and described it before Maitreya Muni. To avenge the sad death of his father by the Rākṣasas, he killed many of them in a sacrifice. Pulastya intervened and the Rākṣasas were saved from further molestation.

He is the reputed author of the *Parāśara-saṃhitā* which is quoted as an authority in the Kaliyuga on questions of conduct and usage to be observed by the Hindus. The *Parāśara-saṃhitā* has been printed in Calcutta, Bombay and in many other places.

He is mentioned in the *Kāśyapa-saṃhitā* to be one of the eight original authors of medical texts in ancient time.

PARĀŚARA II

The saga Parāśara was one of the disciples of Punarvasu Ātreya. He wrote a treatise on general medicine, *Parāśara-saṃhitā,* which is not available now. He is, however, quoted by Śivadāsa, Vijaya Rakṣita and Śrīkaṇṭha Datta. His name is mentioned in the *Sūtra-sthāna* (xvii. 21) of Vāgbhaṭa I. In the *Hastī-āyurveda* by Pālakāpya his name occurs in the list of sages who were invited by Romapāda to learn the science of treatment of elephants. The following formulae are ascribed to Parāśara: 1. Parāśara Ghṛta, 2. Amṛtādamṛta.

VṚDDHA SUŚRUTA OR SUŚRUTA I

Suśruta, the elder, is so called in contradistinction to Suśruta II or the redactor of the original *Sauśruta-tantra.* This original treatise was afterwards recast by the celebrated Buddhist chemist, Nāgārjuna and received the name of *Suśruta-saṃhitā.* The commentators sometimes refer to the treatise of Suśruta, the elder, so it is possible that the original treatise was available to them.

For an account of the *Sauśruta-tantra,* the original treatise of Suśruta, we have no reliable source of information. We cannot isolate the *Sauśruta-tantra* from the *Suśruta-saṃhitā.* But we are certain that the original *Sauśruta-tantra* was a different work, as the quotations from it in the commentaries are not to be found in the *Suśruta-saṃhitā.*

As regards the authorship of *Suśruta-saṃhitā* and its age, I quote here what I wrote about Suśruta in my *Surgical Instruments of the Hindus,* vol. I, pp. 11-18 :

The next treatise on Hindu Medicine is the *Suśruta-saṃhitā.* Suśruta was the son of the sage Viśvāmitra, a contemporary of Rāma. He learned the Science of Medicine from Divodāsa, surnamed Dhanvantari, king of Benares, at his Himalayan retreat. According to Suśruta, Divodāsa was the incarnation of Dhanvantari, the celebrated physician of the gods in heaven, and he first propounded the Art of Healing in the world. Suśruta represented the Surgical School while Caraka was preeminently a Physician in practice.

As regards the authorship of the book, opinions differ. To Suśruta, Dhanvantari addressed his lectures on Major Surgery, which he reproduced in this work. But in the opening lines of the book, salutation is offered to Brahmā, Dakṣa, Aśvins, Indra, Dhanvantari, Suśruta and others. This shows that Suśruta cannot be the author of the work or at least of the work in its present shape, for no author can offer salutation to himself. By "the others" are no doubt meant the notable surgeons who practised and taught the Science of Surgery and who were either contemporary with or posterior to Suśruta.

Possibly the original *Suśruta-saṃhitā* had been recast and the redactor could appropriately offer a salutation to the original author and to other surgeons who flourished before him. There is also an Indian medical tradition, noted in Ḍallaṇā-cārya's *Commentary*, which assigns the improved and supplemented edition of Suśruta's original work to Nāgārjuna, the celebrated Buddhist chemist, who is said to have been a contemporary of the king Sātavāhana.

In the third chapter, Suśruta enumerates the subjects described by him—the chapter forming an index of the book. Therein he mentions the five principal divisions of his book and says that the *Uttara-tantra* or the Supplement would be described afterwards. Now the fact that the sixth part was appended to the work as a Supplement or *Uttara-tantra* (i.e., "after-treatise") clearly shows that it was written afterwards by another surgeon and added to the original treatise. If the original Suśruta wished to have six divisions of his book, he would have mentioned it clearly in the index and would not have, after stating that his book consisted of five parts, added that "the Supplement would be described afterwards", which seems to be an interpolation of the Supplementor to pass his edition as the original work of the author. Again, at the end of the fifth section, there is a passage describing the importance of the Āyurveda, which was meant as the conclusion of the book by the author. It is to be noted that at the end of no other sections do we find a similar passage. He also writes : "Thus one hundred and twenty chapters are described", but adds : "The other diseases shall be described in the *Uttara-tantra*" : the latter part no doubt is an interpolation of the Supplementor. Moreover, in the opening lines which serve as a preface to the sixth part, the authority quoted for the diseases of the eye is Nimi, the king Janaka of Mithilā and not Dhanvantari. But in the first chapter of the first section, it is described that sages wanted Dhanvantari to teach them Śalya Tantra or Major Surgery only and he consented to their request. And this subject he treated in detail in the five sections of the book. In the *Supplement*, on the other hand, are described the other

branches of the science such as Minor Surgery, Inner Medicine, etc. Probably this part was added afterwards to give completeness to the treatise ; and the original Suśruta was called Vṛddha or the Old by the commentators to distinguish him from the Supplementor.

Suśruta's work is specially important to us as having two whole chapters (vii and viii of Section 1) devoted to the descriptions of Surgical Instruments and one whole chapter (xxv of Section 1) to the principles of Surgical Operations.

The age of Suśruta is also involved in obscurity. Nothing can be ascertained from the fact that he was a son of Viśvāmitra, for the age in which the latter lived is not known to us. But he must have flourished during the Vedic Age as many Vedic Hymns are ascribed to him. In the *Mahābhārata*, Suśruta is mentioned as one of the sons of Viśvāmitra and in the *Suśruta-saṃhitā* the author is often described as his son. The age of the great epic has, with good reasons, been fixed at 1000 B.C. So Suśruta must have flourished much earlier. The latest limit which we can assign to Suśruta is 600 B.C. as "there are indications in the *Śatapatha-brāhmaṇa*, a secondary Vedic work, that the author of it was acquainted with the doctrines of Suśruta" as regards the Osteology. "The exact date of that work is not known, but it is with good reason referred to the sixth century B.C." Again in the *Atharva-veda*, in the tenth book, there is a hymn on the creation of man in which the skeleton is described according to Ātreya and Suśruta. "The large portion of it (Books I to XVIII) indeed admittedly belongs to a much earlier period, possibly as early as about 1000 B.C. ; and the hymn in question is included in this older portion." This shows that Suśruta could not have flourished later than 1000 B.C.

Again in the *Hastī-āyurveda*, a book on the *Treatment of Elephants* by Pālakāpya, we find the surgical instruments described after the manner of Suśruta. Pālakāpya lived as a veterinary surgeon in the court of Romapāda, King of Aṅga, which had as its capital the famous town of Campā, identified with the modern town of Bhagalpur. King Romapāda was contem-

porary with King Daśaratha, the father of Rāma, the hero of *Rāmāyaṇa.* Here we have a corroborative evidence of the age of Suśruta.

Suśruta is mentioned in the *Vārttikas* of Kātyāyana who flourished during the fourth century B.C.

In an article, *Midwifery in India,* contributed to the *Indian Medical Record,* 1924, I pointed out the uncertainty about the dates of the ancient authors as follows :

The uncertainty about the dates of the medical authors in Ancient India is well known. Opinions differ as to the time of their existence within wide limits. Let us take the example of Suśruta. Haas considered Suśruta to have flourished in the 12th century A. D., Wilson thought that Suśruta and Caraka lived in the 10th century; and this view was adopted by the Editors of *Pharmacographia Indica* (p. 354). Lanceraux in his *Treatise on Syphilis,* Vol. I, p. 9, remarked that *Suśruta,* the Hippocratic treatise on Indian medicine, was written about the year 400 A. D. Macdonell concluded that Suśruta lived not later than the 4th century *(History of Sanskrit Literature,* Appendix, p. 436). Lietard *(Lettres historiques sur l'etat de la medicine chez les Hindous,* Paris, 1863) traced the origin of the Āyurveda of Suśruta to the beginning of the Christian era. In his *Lectures on Surgery* Bilroth says : "The *Āyurveda* ("Book of the art of life") is as regards medicine, the most important work in Sanskrit, was composed by Suśruta; this work most probably first appeared in the time of the Roman Emperor Augustus" (Vol. I, p.4). Hessler in his Latin translation of *Suśruta-saṃhitā* assigned the appearance of the work to a remote period of Indian history—the heroic age of India—the beginning of which is lost in the immensity of time, and the end of which is known to be about 1000 B.C. In the *Twentieth Century Practice of Medicine,* Vol xviii, p. 621, Suśruta is said to have flourished many centuries before Christ, the exact date being unknown; but as there was reference to Ātreya's description of the seven varieties of Leprosy, there could be no doubt that the work was composed before

600 B. C., for the disease was well-known to Indians and the Chinese at that period. Hoernle *(Osteology of the Hindus,* Introduction, p.8) considered his date to be 600 B.C., and possibly earlier. In my work, *The Surgical Instruments of the Hindus,* I expressed the opinion that Suśruta could not have flourished later than 1000 B. C. Naturally I felt a little surprised as Dr. Das maintained that Suśruta lived in the 5th century A. D. I enquired about his authority for such a statement even after the recent contributions on the subject, and I succeeded in hitting upon his original. If we compare the two passages quoted below we would find that Das omitted the qualifying words of Neuberger, and has thus got the date 5th century for Suśruta—a conclusion very different from that of Neuberger.

Neuberger writes : "The most renowned representative of the medical literature of India are Caraka, Suśruta, Vāgbhaṭa —the ancient trio...Caraka probably lived about the commencement of the Christian era; Suśruta was, in the fifth century A.D., *looked upon as an author of a far distant past*; and as regards Vāgbhaṭa his genuine work...can hardly have originated later than the seventh century A. D." *(History of Medicine,* Vol. I, p. 47).

Das says : "The most renowned representative of the literary monument are the ancient trio—Caraka, Suśruta, and Vāgbhaṭa. Caraka probably lived about the commencement of the Christian era, Suśruta during the fifth, and Vāgbhaṭa, not later than the seventh century A.D." *(Indian Medical Record,* 1924, pp. 40-42).

On a comparison of the two passages quoted above, it would be found that Das omitted the qualifying words (the italics are ours) of Neuberger and thus concluded that Suśruta lived during the fifth century A. D.; but the conclusion, it must be stated, was very different from, and was not warranted by, the statement of Neuberger.

Haas marks two periods in the development of Hindu medicine :

1. *Earlier period* (The Caraka period) : This period extends down to the arrival of the Arabs in India who brought with

them the knowledge of Greek medicine. To this period belong the treatises which are no longer identifiable.

II. *Later period* :

a) Early : Vāgbhaṭa's *Aṣṭāṅga-hṛdaya* and

b) Suśruta—12th Century ?

"That neither of the two works now known as the Caraka and the Suśruta can be accepted as ancient and original compositions, has been clearly shown by Dr. E. Haas in his two essays in the *Journal of the German Oriental Society* (Vol, xxx, p. 617 and Vol. xxxi, p. 647). The *Suśruta,* especially would seem to be a comparatively modern compilation, somewhat loosely and unscientifically put together in the manner of the Purāṇas." *(J.A.S.B.,* lxi., p. 146.*)*

Dr. Haas' theory of the origin of the work is that Suśruta is the Indian adaptation of the Arabic name Suqrat which is a confusion with Buqrat, the Arabic corruption of Greek Hippokrates. Kāśī is an adaptation of the Island of Cos (Kios) known to the Arabs as the native land of Hippokrates (See Haas' *Essay on the Origin of Hindu Medicine, Zeitsch d. D. Morg. Ges.* xxx, p. 617 *seq.*).

But such views however cannot be maintained. Kāśī is not the place where Hindu medical science took its origin, Dhanvantari lectured on the science in his Himalayan retreat. The name Suśruta occurs in the *Bower MS.*, the date of which has been fixed at the 4th century A.D. (See *J. A. S. B.*, Vol. lx, part I). The *Book Suśruta* was translated into Arabic in the 8th century A. D. Sarad is mentioned by Rhazes (see Paul VI. lxi, *Commentary*, Vol. ii, p. 362. *Syd. Soc.* ed.).

Redaction : We have alluded to Nāgārjuna, the Buddhist chemist, as the redactor of the *Suśruta-saṃhitā.* He is said to have been a contemporary of King Kaniṣka, that is, about the first century B.C.

Another revision was undertaken by Cāndraṭa, the son of Tīṣaṭa, the author of *Cikitsā-kalikā.* He revised the text which must have fallen then into a state of corruption. The probable date of Cāndraṭa is the ninth century A. D.

There is no doubt of the tradition that Suśruta's work was

redacted, for the author could not write such a passage as follows : "The surgical treatises of Aupadhenava, Aurabhra, Suśruta and Pauṣkalāvata form the basis of other treatises on the subject."

There is a shorter recension of the book, *Laghu-suśruta* (MS. Pheh, 2), and another MS. of an epitome of the treatise is known *(Suśruta-sāra,* MS, *Radh,* 23).

Commentaries : 1. Cakrapāṇidatta—*Bhānumatī*—1060 A. D, 2. Gayadāsa—*Nyāya-candrikā* or *Pañjikā*—11th century A. D, 3. Jejjaṭācārya, 4. Bhāskara, 5. Mādhava, 6. Brahmadeva, 7. Ḍallaṇācārya—*Nibandha-saṃgraha*— 12th century A. D., 8. Ubhalṭa (Kashmir)—12th or 13th century A. D., 9. *Gūḍha-pada-bhaṅga-ṭippaṇa*—quoted in *Nibandha-saṃgraha* pp. 968 and 1183, 10. *Suśruta-śloka-vārttika-praśnavidhānākhya-ṭīkā*—quoted in *Vyākhyā-madhu-kośa*, p. 14.

CARAKA

Origin of the Caraka-saṃhitā : In the *Caraka-saṃhitā* we find that Brahmā taught Dakṣa the science of medicine; Dakṣa became the preceptor of the Aśvin twins; they in their turn became the teachers of Indra and Indra imparted this knowledge to Bharadvāja who was sent by a conclave of sages to learn the art for the welfare of the human race. Bharadvāja had Punarvasu, Ātreya and others as disciples. Ātreya's students were Agniveśa, Bhela, Jatukarṇa, Parāśara, Hārīta and Kṣārapāṇi, all of whom became celebrated as authors of *Treatises on Medicine*; the *Caraka-saṃhitā* being a revised and improved edition of the treatise of Agniveśa, which was declared to be the best production. Caraka did not, however, redact the whole book; the last forty-four chapters were edited by Dṛḍhabala, a native of Pañcanadapura, long supposed to refer to the Punjab (the land of five rivers) but at present identified with a town in Kashmir by Dr. Hoernle. Two other works, the treatises of Bhela and Hārīta, are still extant; the former existing in manuscript in the Tanjore Library and the latter as printed text by Kavirājas K. C. Sen and B. L. Sen of Calcutta.

Age of Caraka : Now as regards the age of Caraka, there is great divergence of opinions. The Indians generally believe him to be a Ṛṣi of great antiquity while the European scholars try to connect him with historical events of more modern times. Sylvain Levi has recently discovered in the *Chinese Translation of the Buddhist Tripiṭaka* that Caraka was the Court Physician of the Indo-Scythian King Kaniṣka, in the First century A. D. (See *Journal Asiatique*, July to December, 1896, pp. 444-484, and January to June, 1897, pp. 5-42; also *Indian Antiquary*, Vol. xxxii, 1903, p. 382, and *Vienna Oriental Journal*, Vol. xi, p. 164). But the following objections are to be met with before his conclusions can be accepted as proved :

1. The age of Kaniṣka is not yet settled, the probable limits of his reign beign from the first century B.C. to the second century A.D. Moreover in the Buddhist *Tripiṭaka* referred to, the name of Caraka is simply mentioned as the Court Physician of the King Kaniṣka but there is nothing to identify him with the author of the book. The same name, found in different places, does by no means signify the same person.

2. The time assigned to Caraka by the Indian medical tradition is of great antiquity. With regard to the chronological position of the three old authors, he is mentioned as anterior to Suśruta and Vāgbhaṭa I.

3. Dr. Ray has pointed out that the name Caraka is patronymic in the Veda. It is quite possible that a much later namesake of his is referred to by the *Tripiṭaka*, just as we know that more than one Vāgbhaṭa appeared as successful physicians. Again we have evidence that eminent physicians in later times were called Caraka by way of compliment and so Vāgbhaṭa was called Caraka of Sindh or Sindhicara.

4. Pāṇini wrote special *sūtras* for the Agniveśas and the Carakas *(Pāṇini*. iv. 3. 107; iv.1. 105*)*. These names must have been famous before Pāṇini's time, otherwise he would not have written special *sūtras* for them. Prof. Goldstucker has conclusively proved that Pāṇini could not have flourished later than the sixth century B.C.

5. Patañjali wrote a commentary on Caraka (quoted in *Laghumañjūṣā* of Nāgeśa Bhaṭṭa (Ray). He flourished during the second century B.C. Both Cakrapāṇidatta and Bhoja allude to him as the redactor of *Caraka-saṃhitā*. So Caraka must have flourished long before him, for unless his work was regarded as a standard work of authority, Patañjali would not have taken so much pain to write notes on the book, and still more for issuing a redaction.

6. The internal evidence of the book itself speaks against such an assumption. There is no salutation to any deity at the beginning of the book—a custom invariably found to be observed in the more modern compilations. There is complete absence of Paurāṇic theology in the *Caraka-saṃhitā*, nor is there any reference to Śākya Muni and his religion. Kaniṣka was a great patron of Buddhism, and it might naturally be expected from the Court Physician of the King to describe the charitable hospitals which we know from the edicts of Aśoka to have flourished in every quarter of India. On the contrary we find description of a hospital as reserved for rich men only at their own houses. Those gods and goddesses that figure so prominently in the *Purāṇas* were unknown during his time. Beef was not then, apparently, a forbidden food, for it is spoken of as an article of diet that should not be indulged daily, nor should it be used in excessive quantity as it is mentioned as a cause of the disease, Vāta-rakta or leprosy.

The style of the book is antiquated and decidedly savours that of the *Brāhmaṇas*. Nyāya and Vaiśeṣika systems occur in the text, and so probably the book was written long before the compilation of these *sūtras*.

Translations : Caraka was translated from Sanskrit into Arabic in the beginning of the eighth century and his name "Sharaka Indianus" occurs in the Latin translations of Avicenna, Rhazes and Serapion. "*A translation of the Karaka* from Sanskrit into Persian and from Persian into Arabic is mentioned in the Fihrst (finished 987 A. D.). It is likewise mentioned by al-Bīrūni; the translation is said to have been made for the Barmekides." al-bīrūni's chief source on medicine was "Caraka,

in the Arabic Edition of Ali Ibn Zain, from Trabaristan." It had been translated into English by A.C. Kaviratna, Calcutta, 1920 A. D.

The commentators of the Caraka and their commentaries : 1. Patañjali—2nd century B.C.—His commentary is not available, 2. Īśānadeva, 3. Hariścandra or Śrī Hari Candra—1111 A.D. Ms.—Oxf. 187b., G.O.M.L. 13092, 4. Vyāpya Candra, 5. Vakula, 6. Ācārya Bhīmadatta, 7. Bhiṣaka Īśvara Sena, 8. Naradatta, 9. Jinadāsa, 10. Jaijjaṭa or Jejjaḍa, 11. Guṇākara, 12. Cakrapāṇidatta's commentary : *Āyurveda-dīpikā* or *Caraka-tātparya-ṭīkā*—1060 A.D., 13. Śivadāsa Sen—his commentary is called *Caraka-tattva-pradīpikā*, 14. Narasiṃha Kavirāja : *Caraka-tattva-prakāśa-kaustubha-ṭīkā*, 15. Ācārya Svāmi-Kumāra : *Caraka-saṃhitā-vyākhyā (Pañjikā)*, 16. Gaṅgādhara : *Jalpa-kalpa-taru*, Berhampore, 1879 A.D., 17. Vaidyaratna Jogindranath Sen. His commentary is known as *Upaskāra*.

Only the six last-named commentaries are known to exist; the works of the previous authors are known only from quotations.

Besides his redaction of the *Agniveśa-tantra*, Caraka is said to have composed a Commentary on the treatise of Agniveśa—*Agniveśa-ṭīkā* (Ms.—S. B. 284) and *Kṛṣṇa-veda-ṭīkā*—Caraka, as the author of a commentary on *Kṛṣṇa Yajurveda*, is quoted in Ms.—Oxf. 187 b. See also G.O.M.L. 13092.

We learn from the *Caraka-saṃhitā* that the *Agniveśa-tantra* was redacted by Caraka. He explained fully what was brief and obscure in the original treatise, and curtailed what was superfluous. Thus the *Tantra* was practically re-written.

Besides the *Agniveśa-tantra*, Caraka consulted the works of all the disciples of Ātreya. But Caraka did not redact the entire work; the last seventeen chapters of the *Cikitsā*, the *Siddhi* and the *Kalpa-sthānas* were redacted by Dṛḍhabala of Pañcanadapura.

Caraka is said to have been the son of Viśuddha, a learned *muni*, who flourished during the Vedic period. Some believe him to be a native of Benares. But the term *viśuddhasya* may not be the name of any sage—it simply means "of pure character."

In another account, Caraka is said to have been an incarnation of *Śeṣa*—the serpent-god with a thousand heads—who is supposed to be the depository of all sciences, especially of medicine. Serpents were the ornaments of Śiva, from whom the Science of Medicine is supposed by some to have originated. "Serpents were sacred to Aesculapius, the Grecian god of the medical art because they were symbols of renovation and were believed to have the power of discovering the healing herbs."

According to al-Bīrūni (*India*, translated by E. Sachau, Vol. i, pp. 158-9; cf. Reinaud, *Memoire*, p. 316), Caraka, i.e., the intelligent one, was at that time believed to be only another designation of Agniveśa.

The name of Caraka—a Rākṣasa occurs in the *Mahābhārata* (Śāntiparva, Chs. 35-38).

In the *Śrīmad-bhāgavat*, XII, Ch. vi, Caraka is mentioned as one of the sages, who are said to have been propagators of the Vedas. (See 'Table of Teachers and Disciples of Vedic Studies', p. 567).

But Caraka is a family name, and the Kapiṣṭhala Caraka is the name of an old Caraka School of Vedic times.

The medical authors mentioned in the *Caraka-saṃhitā* : 1. Ātreya Punarvasu, 2. Aṅgirā, 3. Jamadagni, 4. Vasiṣṭha, 5. Kāśyapa, 6. Bhṛgu, 7. Ātreaya, 8. Gotama, 9. Sāṃkhya, 10. Pulastya, 11. Nārada, 12. Asita, 13. Agastya, 14. Vāmadeva, 15. Mārkaṇḍeya, 16. Āśvalāyana, 17. Pārīkśi, 18. Bhikṣu Ātreya, 19. Bharadvāja, 20. Kapiṣṭhala, 21. Viśvāmitra, 22. Āśvarathya, 23. Bhārgava 24. Cyavana, 25. Abhijit, 26. Gārga, 27. Śāṇḍilya, 28. Kauṇḍiṇya, 29. Vrākṣī, 30. Devala, 31. Gālava, 32. Sāṅkṛtyāyana, 33. Vaijavāpi, 34. Kauśika, 35. Vādarāyaṇa, 36. Vaḍiśa, 37. Kāṅkāyana, 38. Śaralomā, 39. Kāpya, 40. Kātyāyana, 41. Kaikeśaya, 42. Dhaumya, 43. Marīci, 44. Kaśyapa, 45. Śarkarākṣa, 46. Hiraṇyākṣa, 47. Lokākṣa, 48. Paiṅgi, 49. Śaunaka, 50. Sākunteya, 51. Maitreya, 52. Maimatayāni and others, 53. Brahmā, 54. Dakṣa, 55. Aśvins, 56. Indra, 57. Agniveśa, 58. Bhela, 59. Jatukarṇa, 60. Parāśara, 61. Hārīta, 62. Kṣrāapāṇi, 63. Kumāraśirā Bha-

radvāja, 64. Rājarṣi Vāryovid, King of Kāśī, 65. Rājarṣi Vāmaka, 66. Dhanvantari, 67. Asita Gotama, 68. Dṛḍhabala.

Gods and godesses mentioned : 1. Brahmā,, 2. Indra, 3. Lakṣmī 4. Jayā and Vijayā, 5. Viṣṇu, 6. Viśvakarmā, 7. Kṛṣṇa, 8. Vāsudeva, 9. Vṛṣadhvaja.

DṚḌHABALA

Caraka did not redact the whole of the *Agniveśa-tantra*; the last 41 chapters, i.e., 17 chapters of the *Cikitsita*, 12 chapters of the *Kalpa* and 12 chapters of the *Siddhisthāna*, were completed by Dṛḍhabala.

Dṛḍhabala was an inhabitant of Pañcanadapura. Now the question arises where is Pañcanadapura. The word literally means "the land of five rivers." And as such, claims have been put forward for four different localities :

1) It is generally identified with the Punjab, lit. *Pañca-Ap* or Land of five Waters, *(Śabdakalpadruma)*. But Hoernle says, "The usual identification of Pañcanada with the Punjab is untenable ; for Dṛḍhabala clearly indicates a locality *(pura)*, not a country as his home." (*Osteology*, Intro., p. 3, f.n. 1)

2) Gaṅgādhara identifies Pañcanadapura with Benares in his *Jalpa kalpataru*. *Pañcanada-tīrtha* is one of the names applied to the city of Benares or Kāśī. It means the sacred place of pilgrimate where five rivers or *Pañca-gaṅgā* or five Ganges meet. The five rivers are Kiraṇā, Dhūtapāpā, Sarasvatī ; Gaṅgā and Jamunā *(Kāśī-khaṇḍa*, ix. 114-15).

Kāśī is described as a "pura". It is called *Sivapurī* (see *Haima-kośa)*. So Pañcanadapura may refer to Benares.

3) Hoernle remarks : "In India the confluence of streams is apt to be treated as a sacred place of pilgrimage *(tīrtha)*; and there are several such places called Pañcanada. Anciently one of them appears to have existed in Kashmir, near the confluence of the rivers Jhelam *(Vitastā)* and Sindhu. Its place is indicated by the modern village of Pantzinor (lit., five chan-

nels), which lies close to what was the original site of that confluence, before its removal to its present site, in the latter half of the ninth century, in the reign of King Avantivarman. It was this Kashmirian Pañcanada, which probably was the home of Dṛḍhabala." In the footnote he adds, "See Dr. Stein's Translation of the *Rāja-taraṅgiṇī*, Ch. iv, 248, v. 66ff. ; also his account of the removal of the confluence, vol. ii, pp. 239 ff., 419 ff."

4) Hoernle continues : "Dr. Cordier, in his *Recentes Decouvertes,* identifies it with 'Panjpur and nord d'Attock, Panjab,' on the authority, as he has informed me privately (letter of January, 13, 1905) of 'an Indian Nagri map lithographed in Benares' and of 'the Indian Post Office Guide.' I am afraid he has been misled by his authorites. Dr. Stein, whom I asked to verify on the spot, writes to me (letter of March 1, 1905) that there is no Panjpur in the region of Attock, nor in the 'latest editian of the Indian Postal Guide'. There is, however, an isolated ridge known as Panjpir, or 'Hill of the Five Pirs', in the Yusufzai Plain, NNW of Attock, a Muhammadan place of pilgrimage. This appears to have caused the confusion ; but between Panjpir and Pañcanadapur there can obviously be no connexion. See also my article on the *Authorship of the Caraka-saṃhitā* in the *Archiv fur die Geschichte der Medizin,* 1907." (Hoernle, *Osteology,* Introduction, f.n. I, p. 3).

Now though all agreed that the last seventeen chapters of the *Cikitsita-sthāna* were redacted by Dṛḍhabala, it was difficult to decide which amongst the thirty chapters of the *Cikitsita-sthāna* belonged to Dṛḍhabala, for they stood differently in the various texts.

The Age of Dṛḍhabala : It is very difficult to decide the age of Dṛḍhabala. Different views have been put forward as to the chronology of Dṛḍhabala, Vāghhaṭa I, Vāgbhaṭa II, and Mādhava.

Hoernle thinks that Mādhava is anterior to Dṛḍhabala.

Bendal says, "Dṛḍhabala's age, it is difficult, to settle. But I will hazard a conjecture that he wrote when the last Hindu Dynasty was reigning in the Punjab." (Bendal's *Preface to Nepal*

Catalogue, p. xxi).

In Vijaya Rakṣita's commentary *Vyākhyā-madhukośa*, xxii, 5; ii, 1, 2 (p. 147, Jiv. Ed.; p. 144 C.D. Das's Ed.), there is a remark which suggests the inference that Mādhava was posterior to Dṛḍhabala.

The authorship of the Caraka-saṃhitā : We have noted that Agniveśa wrote a treatise on medicine, which he is said to have learned from the sage Punarvasu Ātreya. Caraka next redacted the *Agniveśa-tantra* up to the thirteenth chapter of the section on treatment. The last seventeen chapters of that section, the *Kalpa-sthāna* and the *Siddhi-sthāna* were completed by Dṛḍhabala.

Now are we sure that the first five sections and the thirteen chapters of the sixth section do not contain any emendation from authors other than Agniveśa and Caraka ? We have shown before that both Agniveśa and Caraka flourished during the Vedic time. We are not certain as to whether Caraka did or did not redact the whole book. We are only told that the last forty-one chapters of the *Caraka-saṃhitā* were not available when Dṛḍhabala wrote.

It is quite possible that Caraka redacted the whole work but the last forty-one chapters became lost afterwards. This shows that the interval of time that elapsed between Caraka and Dṛḍhabala must have occupied many centuries.

He also admitted that he consulted works of different authors in his complimentary text (Siddhi-sthāna, xii).

Thus we find that Dṛḍhabala not only completed the last forty-one chapters, left unfinished by Caraka, but he re-edited the entire book.

Again in the last forty-one chapters, which are undoubtedly known to be the work of Dṛḍhabala, we find interpolations of authors who flourished subsequent to Dṛḍhabala. In *Aṣṭāṅga-hṛdaya-saṃhitā* Vāgbhata II, in one of the concluding verses, "refers to the very insufficient character of the information on the diseases of the eye to be found in Caraka's compendium as compared with that given in Suśruta's compendium." (Uttara-sthāna, ch. xl, v. 83)

But in the *Caraka-saṃhitā*, as we find it now, the treatment of diseases of the eye is described; this could not have been the state of the book when Vāgbhaṭa II wrote, for otherwise he would not have complained of the insufficiency in the chapter on eye-diseases.

It must, however, be remembered that Vāgbhaṭa's complaints concern only with the description of the diseases and not as regards their treatment. Even in the *Caraka-saṃhitā* there is still scarcely any description of the diseases of the eye; only their total number ninety-six is mentioned, referring the curious to other works on surgery or their pathology, symptoms, causes, etc. So Vāgbhaṭa's reference proves nothing as regards interpolations in Dṛḍhabala's work : it simply proves that Vāgbhaṭa II was acquainted with Dṛḍhabala's compilation of Caraka's compendium; i.e., Dṛḍhabala is anterior to Vāgbhaṭa II.

"The early commentators of the eleventh and thirteenth centuries (e.g., Cakrapāṇidatta and Vijayarakṣita) often refer to a Kashmirian Recension (*Kāśmīra-pāṭha*) when commenting on passages of the earlier portion of the Compendium, i.e., the portion written by Caraka himself. The probability is that in all these cases the reference is to Dṛḍhabala's revision of Caraka's work; for in references to the concluding portion of the Compendium, Dṛḍhabala, as a rule, is quoted by name as its author" *(Osteology*, p. 2). This view is based on the assumption that Pañcanadapura,the home of Dṛḍhabala was in Kashmir. But Hoernle also thinks Caraka to be a 'Kashmir physician' (See *Osteology*, p. 2). So it is natural for the commentators to refer to Caraka's edition of the earlier part of the work as the Kāśmīra Recension. This theory also is based upon a conjecture, for we know nothing of the birthplace of Caraka. Again the Kāśmīra Recension might have been the work of a Kasmir physician whose name is lost to us, and possibly he was a different individual altogether, neither Caraka nor Dṛḍhabala.

BHIKṢU ĀTREYA

Bhikṣu Ātreya was a Buddhist by religion and so must have

flourished after Buddha. He was the reputed teacher of Jīvaka, who is said to have been the physician to Buddha, Bauddha Saṅgha and the king Bimbisāra. He was Professor of Medicine at the University of Taxila, where Āyurveda was taught. He was famous in Gāndhāra. He wrote the *Atri-saṃhitā*. The European scholars identify him with Ātreya Punarvasu, the teacher of Agniveśa and others but without any valid reason. This view has however found currency, for Dr. S.C. Vidyabhusana in his *Buddhadeva*, p. 221, echoes the same opinion.

The question may, however, be asked : "How is it that Bhikṣu Ātreya is said to have been one of the ancient sages who introduced the Science of Medicine in India ?" We must not attach any chronological importance to such myths as we find in the *Caraka-saṃhitā*. We do not know the real author of this portion, as the *Agniveśa-tantra* has been redacted by Caraka and Dṛḍhabala and perhaps by others. If we find the names of sages associated in a medical controversy, we must not take it as a historical proof of their contemporaneity. Dṛḍhabala edited and completed the latter part of *Agniveśa-tantra* which was left unfinished by Caraka, but we find at the end of each chapter of Dṛḍhabala: "Agniveśa's Treatise as redacted by Caraka." In the *Bhāva-prakāśa*, we find the description and treatment of syphilis for the first time, and thus it was undoubtedly never known to the ancients. Bhāvamiśra, however, refers the treatment of the disease to the old sages : "So said the sages in bygone times."

The opionion of Bhikṣu Ātreya is quoted in the *Caraka-saṃhitā*, I. xxv, where he is said to have discussed on the origin of diseases and expressed his opinion : "The ever-kind God cannot be the cause of sorrow or disease in his subjects. I think that both men and diseases and produced by Time. The whole world is dependant on Time; therefore Time is the sole cause."

Punarvasu Ātreya was a different sage. It would be at once proved from the fact that the above opinion of Bhikṣu Ātreya was not approved by Punarvasu Ātreya, who next explained the cause of disease to be simply unwholesome food. "Those factors which by their combination produce happiness

in men, cause disease by their misuse."

Lord Ātreya said, "The use of good food is the cause of happiness in men; the use of unwholesome food is the cause of diseases."

Hippocrates, it would be interesting to note, held practically the same view in the causation of disease. In one of the Hippocratic Treatises—*On the Nature of Man*—Adams refers to the view that disease in general are occasioned either by the food we eat, or the air we breathe, those which prevail epidemically being produced by the latter cause. All sudden changes of diet are held to be attended with danger, and to be avoided.

Ātreya in Navanītaka (Bower MSS) : The following formula are attributed to Ātreya : 1. Laguḍa Cūrṇa, 2. Śārdūla Cūrṇa, 3. Amṛtaprāśa ghṛta, 4. Mahākalyāṇaka ghṛta, 5. Balā-taila, 6. A mutilated formula (prose).

JĪVAKA

Jīvaka *(6th Century B.C.)* was the well-known physician of Buddha's time. He was the physician-in-ordinary to King Bimbisāra. He was appointed to undertake medical attendance, not on the king and his women only, but also on the venerable Buddha and his Order. In the *Mahāvagga*, he is said to be the son of Salāvatī, the courtezan of Vesālī. As regards his birth, he is said to be an illegitimate son of Prince Abhaya and grandson of King Bimbisāra according to one version, while, according to another, he was an illegitimate son of King Bimbisāra himself and a younger brother of Prince Abhaya. The boy was forsaken by the mother and Prince Abhaya brought him up in the royal palace, and so he was called Komarobhacca *(kumarena posapito)*. The etymology of the term is fanciful, as the title Kumarabhṛtya (Pali, Komarabhacca) or "Children's doctor," which clearly indicates him as having been particularly skilful in paediatrics, is derived from one of the eight divisions of the science of medicine—*Kaumārabhṛtya*, and it really means "Master of the Kaumārabhṛtya Science." He learned the science of medicine from a world-renowned physician,

Ātreya, at Takṣaśilā. He studied there for seven years, and satisfied his teacher. Many wonderful cures are related of him. He set out for Rājagṛha at Sāketa (Oudh), he cured the Śeṭṭhi's wife who had been suffering for seven years from a disease in the head by once giving her medicine through the nose, and thus earned a good deal of money. He reached Rājagṛha, cured the Magadha king Seniya Bimbisāra of a fistula by one anointing, and was appointed physician to the king and his seraglio, and the Bauddha fraternity of Bhikṣus with the Buddha at its head. Next he performed a cranial operation on a Śeṭṭhi at Rājagṛha. He ordered the Śeṭṭhi "to lie down on his bed, tied him fast to his bed, cut through the skin of the head, drew apart the flesh on each side of the incision, pulled two worms out (of the wound) and showed them to the people. He closed up the sides of the wound, stitched up the skin on the head and anointed it with salve," and enjoined perfect rest for three weeks.

Next he performed a laparotomy on a Śeṭṭhi's son at Benares : he tied him fast to a pillar, placed his wife in front of him, cut through the skin of the belly, drew the twisted intestines out, put the intestines back (into their right position), stitched the skin together, and anointed it with salve. His next patient was King Pajjota (of Ujjene) who was suffering from jaundice, and who was soon cured of his malady. He thus earned a fortune by his marvellous cures and he helped the Bhikṣus with his riches. Jīvaka is referred to in the *Sūtra of the Fruit of Asceticism* as inducing Ajātaśatru to visit Buddha. Tradition assigns him to the court of King Ajātaśatru and makes him a contemporary and friend of Buddha.

The following formulae are ascribed to Jīvaka :

1. In the *Bower MS.* the following formula for diseases of children occurs (Verse 1081), "Bhārgi *(Clerodendron siphonanthus)* long pepper, Pāṭhā *(Stephania hermandifolia)*, Payasyā *(Gynandropsis pentaphylla)*, together with honey, may be used as a linctus against emesis due to deranged phlegm. So says Jīvaka."

2. In the *Cakradatta*, Soureśvara Ghṛta is ascribed to Jīvaka. Śivadāsa explains Jīvaka as : *jīvo bṛhaspatiḥ, svārthe kaḥ.*

3. Another formula, ascribed to Jīvaka, is quoted by commentators.

In the *Sumaṅgala-vilāsinī* (the commentary in the *Dīgha Nikāya* of the *Sutta-piṭaka,* written by Buddhaghoṣa), we find interesting material for the study of the life of Buddha and his contemporaries. It contains the story of Jīvaka but shows a popular version of it. It differs from the accounts as preserved in more reliable sources.

Jīvaka is referred to in the *Sūtra of the Fruit of Asceticim* as inducing Ajātaśatru to visit Buddha : "The *Sūtra* relates how king Ajātaśatru of Magadha in the 'Lotus night' that is in the full moon of October, the time when lotus blooms, is sitting in the open air, surrounded by his nobles on the flat roof of his palace. 'Then,' as it is recorded in that text, 'the king of Magadha, Ajātaśatru, the son of the Videha princess, uttered this exclamation : Fair in sooth is this moonlight night, lovely in sooth is this moonlight night, grand in sooth is this moonlight night, heart-enchanting in sooth is this moonlight night, happy omens in sooth giveth this moonlight night; what Sramaṇa or what Brāhmaṇa shall I go to hear, that my soul may be cheered when I hear him ? One counsellor names this and another that teacher; but Jīvaka, the king's physician, sits on in silence. Then the king of Magadha, Ajātaśatru, the son of Videha, spake to Jīvaka Komarabhacca : 'Why art thou silent, friend Jīvaka ?' 'Sire, in my mango grove he resteth, the exalted, holy, supreme Buddha, with a great band of disciples, with 300 monks. Of him, the exalted Gotama, there spreadeth through the world loudly praise in these terms : He, the Exalted One, is the holy, supreme Buddha, the wise, the learned, the blessed, who knoweth the universe, the highest, who tameth man like an ox, the teacher of gods and men, the exalted Buddha. Sire, go to hear him, the Exalted One; perchance, if thou hearest him, the Exalted One, thy soul, O sire, may be refreshed'—and the king orders elephants to be prepared for himself and queens, and the royal procession moves with burning torches on the moonlight night through the gate of Rājagaha to Jīvaka's mango grove, where Buddha is said to

have held with the king the famous discourse 'On the Fruits of Asceticism' at the end of which the king joined the church as a lay member !" (Oldenburg, *Buddha*, p. 147).

For an account of the life of Jīvaka, we have quoted from :

1. *Mahāvagga*, Ch. viii, Transl. S.B.E. Part ii, p. 171.
2. Hardy's *Manual of Buddhism*, Ch. vii, p. 244.
3. Schiefner's *Tibetan Tales*, Ch. vi, pp. 92-109.
4. Beal's *Buddhist Records*, Vol. i, Introduction, lix. and Vol. ii, p. 152.
5. Oldenburg's *Buddha*, p. 147.

VĀGBHAṬA I

The next author of celebrity whose work is still extant is Vāgbhaṭa I or Vāgbhaṭa the elder, the author of *Aṣṭāṅga-saṃgraha* (i.e., *Compilation of the Octopartite Science)*. In later times, a namesake of his wrote another work called *Aṣṭāṅga-hṛdaya-saṃhitā* (or *The Best Compendium, i.e. the Heart of the Octopartite Science)*. In the *Uttara-sthāna*, Vāgbhaṭa the younger distinctly states that his *Compendium* is based on the *Compilation* of Vāgbhaṭa the elder.

As regards the age of Vāgbhaṭa the elder, there is the same uncertainty as with his predecessors. We are however sure that he is posterior to Caraka and Suśruta for he refers to these writers by name.

The chronological relation of the three early authors is described in a popular couplet that Ātreya, Suśruta and Vāgbhaṭa were the three great medical authors for the three *yugas*—the *Tretā*, *Dvāpara* and *Kali* respectively. They are known as the *Bṛddha-trayī* or the Old Triad. This medical tradition goes much against the conclusion of Dr. Hoernle that Vāgbhaṭa I must have flourished early in the seventh century A.D. One of the reasons put forward by him is the fact that "the Buddhist pilgrim I-Tsing, who resided ten years in the Nālandā University (in Bihar) from about 675-686 A.D. states in his *Records of Buddhist Practices* that the eight arts (i.e., the branches of medi-

cine) formerly existed in eight books but lately a man epitomised them and made them one bundle (or book)." Professor Jolly understands by it the *Suśruta-saṃhitā*, while Dr. Hoernle points out with more reason that it refers to Vāgbhaṭa I's work, the *Aṣṭāṅga-saṃgraha* and rules out Suśruta by the word "lately". But the description that I-Tsing gives of the contents of the book does not warrant any reference to either. Moreover, he has not given any reason why Vāgbhaṭa II's book *Aṣṭāṅga-hṛdaya-saṃhitā* might not be alluded to by I-Tsing. Dr. Hoernle, however, rules him out by date for "he cannot be placed earlier than the eighth century"—an assertion unsupported by any evidence whatsoever. All that he has proved is : "Accordingly, it is probable that all these three medical writers (Mādhava, Dṛḍhabala and Vāgbhaṭa II) come in the period from the 7th to the 9th century A.D. at no very great interval from one another." This proof is based on the age of Vāgbhaṭa I as suggested by I-Tsing's remarks. Thus he has taken for granted what he is required to prove. He has shown that Suśruta is anterior to Vāgbhaṭa I and Vāgbhaṭa II is posterior to him. But in trying to prove that Vāgbhaṭa I lived in the seventh century he cannot assume that Vāgbhaṭa II lived in the eighth. Another evidence adduced in support of his conclusion is the fact that the non-medical version of the list of bones of the human body as contained in the law-book of Yājñavalkya presupposes earlier uncorrupted forms of lists of bones both in Caraka and Suśruta, and "the corrupt recension, traditionally handed down, must have come into existence at a later date," that is to say, between the date of Yājñavalkya (350 A.D.) and Vāgbhaṭa I, the latter of whom is proved to have copied from the corrupt recensions of Caraka and Suśruta. Thus the older recensions still existed in the fourth century A.D. and if we add to it the interval of time necessary for the texts to have fallen into a state of corruption, we get the early seventh centure A.D. for Vāgbhaṭa I. But we must remember that there is nothing to prevent us from supposing that Vāgbhaṭa I lived before Yājñavalkya. There might have been two recensions of the texts available during Yājñavalkya's time,

one corrupted, and it might or might not have been the work of Vāgbhaṭa I, and another true version which was availed of by the sage Yājñavalkya. And similar events have happened, as has been pointed out by Dr. Hoernle himself, in our own generation. Gaṅgādhara's recension of Caraka is a corrupted form of the text, while the recension given in Jīvānanda's edition is the traditional text of Caraka. No critic would, I think, jump into the conclusion that Gaṅgādhara lived three or four centuries after Jīvānanda. Again if it be true, as he contends, that Suśruta was redacted by Vāgbhaṭa I, we could easily imagine that Yājñavalkya copied his list of bones from the original *Suśruta* and not from the redaction of Vāgbhaṭa I. So we see that the age assigned to Vāgbhaṭa I, i.e. the seventh century A.D. cannot be accepted as proved. Dr. Hoernle also says : "It should, however, be understood that these conclusions regarding the date and authorship of Vāgbhaṭa I, are not put forward as established fact."

Let us recapitulate the objections that can be urged against the conclusion that Vāgbhaṭa I lived in the seventh century A.D.

1. Vāgbhaṭa I is believed by the Indian medical men to have flourished long before the Christian era. By some, he is connected with the court of Yudhiṣṭhira but his name is nowhere mentioned in the *Mahābhārata*. Ātreya, Suśruta and Vāgbhaṭa are described as the Old Triad or *Bṛddha-trayī* and they were the authorities for the *Tretā*, *Dvāpara* and *Kali Yugas* respectively. It is curious to observe that Dr. Hoernle, in arguing against the conclusion of Prof. Jolly that Suśruta is meant by I-Tsing, takes advantage of this Indian medical tradition that Suśruta flourished during prehistoric times, but does not mention the same tradition with regard to Vāgbhaṭa I, which goes against his own conclusion. On the other hand, the same objection does not apply against Vāgbhaṭa II.

2. The name of Vāgbhaṭa I's book, *Compendium of the Octopartite Science*, no doubt, agrees very well with the description of I-Tsing that "lately a man collected them into one bundle." But Vāgbhaṭa II's book *The Best Compendium of the*

Octopartite Science is equally suggestive, though Dr. Hoernle says : "It cannot prevail by the side of the more suggestive name of the rival work of Vāgbhaṭa the elder."

3. Again in arguing against Prof. Jolly, Dr. Hoernle has attached much importance to the word "lately" by which Suśruta is ruled out of date. Admitting the validity of such reasoning, it does not follow that by the word "lately" I-Tsing meant any contemporary author or any one who preceded him by a short period only. To comprehend the meaning of the sentence we must understand the word "lately" in connection with the word "formerly" used before. Now the sentence "The science of medicine formerly existed in eight books" no doubt refers to the division of *Āyurveda* into eight parts by Brahmā and to the treatises on the different branches of Medicine by Agniveśa, Suśruta and others. These treatises are believed to be of remote antiquity and so any later compilation may be spoken of recent in comparison with the old treatises of unknown ages. Thus the word "lately" may refer either to Vāgbhaṭa I or Vāgbhaṭa II, but the latter author's claim for the honour becomes reasonable considering his decided posteriority to the former and so coming within the limit of the time suggested by the word "lately".

4. Again I-Tsing refers to a book which was recognised as the standard one throughout India. This may refer either to Vāgbhaṭa I or II. But if Vāgbhaṭa I's book occupied such a position at the time of I-Tsing, it becames difficult to imagine why Vāgbhaṭa II should write another work principally based on the work of Vāgbhaṭa I after the lapse of a century or so. Moreover, we find at the present time, that Vāgbhaṭa II's book, *Aṣṭāṅga-hṛdaya-saṃhitā*, has a wider popularity than the book *Aṣṭāṅga-saṃgraha* of Vāgbhaṭa I. The former has been printed many times and is widely read by the students—so much so that Vāgbhaṭa is generally known as the author of the *Aṣṭāṅga-hṛdaya-saṃhitā*.

5. Moreover, the Arabian physician Rhazes, who is said to have lived in the ninth century (882 A. D.), in treating of the property of ginger, the common plantain and other

drugs, qouted from an Indian writer, whom he calls Sindaxar or Sindicara. Royle says : "But in the article *De Allio* another Indian author is qouted, whom I have not been able yet to trace out—*Ait Sindifar* (in another place written *Dixit Sindichar) indianus* valet contra Ventositatem." This Sindicara is identified with Vāgbhaṭa II of Sindh who was in his time known as a second Caraka or Cara, the syllable "ka" making no difference, as in words like *bāla* and *bālaka,* both meaning a child. We know that Vāgbhaṭa's *Aṣṭāṅga-hṛdaya-saṃhitā* was one of the medical works translated by the order of Caliphs in the eighth century.

6. The translations of the *Caraka,* the *Suśruta* and the *Vāgbhaṭa* occur in the Tibetan *Tanjur.* "George Huth, who has recently critically examined the contents of the *Tanjur,* concludes that the most recent date at which it can be placed is the 8th century A.D."

So I cannot avoid the conclusion that of the three authors, Suśruta, Vāgbhaṭa I and II, to which I-Tsing's remarks may refer, the last has probably the best claim to that reference and the date assigned to Vāgbhaṭa I may well suit Vāgbhaṭa II, i.e., "as late as the early 7th century A.D.," and possibly still earlier. Again it is impossible for us to say whether I-Tsing's remarks may not appropriately refer to other authors whose works are lost to us.

Mention should also be made of the fact pointed out by Dr. Cordier that Vāgbhaṭa is mentioned in the *Rājataraṅgiṇī* and his date is fixed there as 1196-1218 A.D.

But the name of Vāgbhaṭa does not occur in Stein's edition of *Rājataraṅgiṇī,* which is no doubt the most reliable, and so we can easily dismiss this view as untenable.

NĀGĀRJUNA

Nāgārjuna the alchemist is universally regarded as the inventor of distillation and calcination. The author of *Rasa-ratna-samuccaya* invokes him in the opening lines. So do *Rasendra-cintāmaṇi* and Cakrapāṇidatta in the *Rasāyanādhikāra.* Vṛnda

and Cakradatta allude to him as the introducer of Kajjvalī (black sulphide of antimony). Ḍallaṇa makes him the redactor of the *Suśruta-saṃhita* : *prati-saṃskartāpīha nāgārjuna eva* (*Nibandha-saṃgraha*, I).

Nāgārjuna's works : The principal medical books attributed to Nāgārjuna are :

1. *Lauha-śāstra* : The Science of Iron.
2. *Rasa-ratnākara* : A Brahmanic and Buddhistic alchemical Tantra ascribed to Nāgārjuna.
3. *Kakṣapuṭa-tantra.*

Formulae attributed to Nāgārjuna : 1. Nāgārjuna-pādānamañjana or Nāgārjuna-varti (or Caturdaśāṅgī-varti)—(This prescription was written on a stone slab in Pāṭaliputra for the public), 2. Nāgārjuna-yoga, 3. Viśvesvara-rasa, 4. Abhravaṭikā, 5. Rasābhra-vatī, 6. Nāgārjunābhra, 7. Bṛhat-pāṇīyabhakta-guṭikā, 8. Mūlikābandhana, 9. Nāgārjunī-guṭikā, 10. Mṛta-sañjīvanī-guṭikā, 11. Siddha-rasa, 12. Nāgārjunī-guṭikā (second), 13. Haridrākhaṇḍa, 14. Kṛmibhadrā-vaṭī, 15. Laghu-siddhābhraka, 16. Ghoḍācolī-rasa.

DHANVANTARI

Dhanvantari is the name of the physician of the gods in heaven. He appeared in this world as Divodāsa, king of Kāśī, surnamed Dhanvantari. In *Suśruta-saṃhitā* he is referred to as the teacher of Śalya Tantra or Major Surgery and he imparted this knowledge to Suśruta, the representative of an assembly of Ṛṣis or sages. He said : "It was I who cured the diseases of the gods and prevented their deaths and decrepitude. I have now come to this world to teach Śalya Tantra and the other divisions of the Āyurveda in detail."

He taught the science of Śalya or Major Surgery to Aupadhenava, Vaitaraṇa, Aurabhra, Pauṣkalavata, Karabīrya, Gopura-rakṣita, Suśruta and others in his Himalayan retreat.

In the *Suśruta-saṃhitā*, Dhanvantari, Divodāsa and Kāśīrāja are the different names of the same individual. But in the *Viṣṇu-purāṇa* and *Harivaṃśa* we find that the names belonged to

two different kings.

Here (i.e. in *Viṣṇu-purāṇa* iv. 8 and *Harivaṃśa* ch. xxix) we find that Divodāsa was either the grandson or great-grandson of Dhanvantari. Again Kāśīrāja appears to be the grandfather of Dhanvantari. It is difficult to say whether Kāśīrāja means King of Kāśī or is the name of a king. "The work called *Nāvanītaka* (in the *Bower MS.*) professes to be by Suśruta, to whom it was declared by the Muni Kāśīrāja. The latter is clearly a proper name, not a title 'a king of Kāśī'." (Hoernle)

Again it is difficult to say whether Dhanvantari the progenitor of the present race of Vaidyas was identically the same Dhanvantari who propounded the science of life in this world. In the *Skanda, Garuḍa* and *Mārkaṇḍeya Purāṇas*, it is stated that Dhanvantari flourished in the Tretā Yuga. His birth is thus narrated :

Once upon a time the sage Gālava became greatly fatigued in search of Kuśa grass, etc., in a forest. He was very thirsty, but finding no water, he came out of the forest. He met a young maiden going home with a pail full of water on her waist. He said : "O maiden ! I am very thirsty; kindly save my life by giving me water to drink." She presented the pail to the sage. He bathed and quenched his thirst to his satisfaction. He was highly pleased and uttered this benediction : "May you be the mother of a worthy son." She blushed and informed him that she was still unmarried, and that she was Vaiśya by caste and Vīrabhadrā by name. The sage then ordered her to follow him to the society of the Munis (hermits) who said, "Be it so, and let Dhanvantari be born of this girl." So they prepared an effigy of *kuśa*, threw it on her lap, animated it with life by chanting Vedic *mantras*; and the boy in beauty and splendour proved an ornament to sweet Vīrabhadrā. The boy was called Vaidya because he was born by the Veda *mantras* and became the famous Ambaṣṭha, from the circumstance of his lying in his mother's lap.

In the *Skanda-purāṇa*, a similar story is narrated. Here the father of the girl Vīrabhadrā is said to have offered the maid to the sage Gālava for marriage. Gālava declined the offer but

fulfilled his benediction by giving her a son, Dhanvantari, the celebrated physician.

Thus we find that the origin of Dhanvantari is a mystery, and this story got currency by the description of supernatural incidents about his birth, so that he might be respected as a god. "The medicines are like sacred water of Ganges and the doctor is like God himself." The truth appears to be that the girl was married to Gālava with the consent of the sages and she gave birth to Dhanvantari in due time. The boy was taught Āyurveda by Bharadvāja and others. That the progenitor of Vaidyas was born of a Vaiśya mother and Brahman father can be proved by passages from the Law books and the Purāṇas.

The renowned Dhanvantari is said to have married the three daughters of Aśvini Kumāra : Siddhavidyā, Sādhyavidyā and Kaṣṭasādhyavidā. He became the father of fourteen sons—Sena, Dāsa, Gupta, Datta, etc. He learned the Āyurveda well but became indifferent to worldly prosperity. So he was made king of Benares by Bharadvāja, Gālava and other sages at the request of Brahmā. He taught Suśruta and other disciples, viz., Aupadhenava,Aurabhra and others.

Now we have here two stories of the birth of Dhanvantari. According to the Purāṇas, he was a Kṣatriya king of Benares. He taught Āyurveda to Suśruta. In the second version, he was the son of a Brāhmaṇa father and Vaiśya mother; and he was afterwards made a king of Benares. In *Suśruta-saṃhitā* there is internal evidence in support of the latter view. He has been styled *nimittāntara-bhūmipaḥ* (S.S., ii.9.), and this remark could not apply to a Kṣatriya king, the son of a reigning family. It has also been objected that Suśruta the son of the royal sage Viśvāmitra by a Vaiśya mother, could not possibly offer a salutation to a Kṣatriya king but could do so to Dhanvantari, the son of Gālava, a Brāhmaṇa.

Another version of the birth of Dhanvantari is that he rose from the ocean when it was churned by Devas and Asuras for Amṛta or nectar. (See *Viṣṇu-purāṇa*, Wilson's translation quoted in Dawson's *Mythology*, p. 13.)

Again it has been argued that perhaps there were two men

called Dhanvantari—one is the Kṣatriya king of Benares, and the second is the progenitor of the Vaidya caste; and that both of them were medical men who propagated the science to the public. Bhāvamiśra held the view that the teacher of Suśruta was Dhanvantari, the Kṣatriya prince born in the family of Vāhu.

The theory of two Dhanvantaris no doubt reconciles both the versions but there is no evidence for believing that there were two such men. Both in *Suśruta-saṃhitā* and Purāṇas, mention is made of a single Dhanvantari, the heavenly physician; as for example we find in *Suśruta-saṃhitā* ii. 1, v. 8, vi. 39.

Disciples of Dhanvantari : He is said to have initiated and taught one hundred disciples in the science of medicine. In *Suśruta-saṃhitā*, i. 1, we find the names of Aupadhenava, Aurabhra, Pauṣkalavata, Karabīrya, Gopura Rakṣita (some commentators think Gopura and Rakṣita to be two persons), Baitaraṇa, Suśruta and others. By "others" are meant such persons as Bhoja, Nimi, Kāṅkāyana, Gārgya and Gālava. So we get names of twelve students.

In the *Bower MS.*, Muni Kāśīrāja appears as the teacher of Suśruta. Dhanvantari is again referred to there as teaching Keśava (or Viṣṇu) the doctrine of Plumbago plant *(Bower MS.*, Ch. xiii, p. 169).

Formulas attributed to Dhanvantari : 1. Dhānvantara Ghṛta or Clarified Butter, 2. Pāśupatarasa, 3. Mṛtuñjaya Lauha, 4. Vāriśoṣaṇarasa, 5. Rasa Rājendra, 6. Vṛhat Pūrṇa Candra Rasa, 7. Pittāntaka Rasa, 8. Rasābhra Guggula, 9. Aśvagandhādya Taila, 10. Saptaviṃśati Guggula (Vaṭikā), 11. Dvātriṃśaka-vaṭikā.

ŚĀLIHOTRA

Of all the sages whose names are mentioned in connection with the teaching of the veterinary science, Śālihotra stands

pre-eminent. He is said to have learned the science from Brahmā, the fountainhead of all medical lore, and to have expounded and taught the science to his disciples. He lectured on the subject of 'Horse and its treatment,' the *Hayāyurveda*, *Aśvāyurveda*, or *Turaṅgama Śāstra*. Some chapters of his book are quoted in the *Agni-purāṇa* (ch. 281). *Hayāyurveda* is also described in *Matsya* (chs. 189 and 191) and *Garuḍa* (chs. 197 and 207) *Purāṇas*. Garga was another ancient writer on horse. His work is not available to us now, but he is quoted by Gaṇa in his work on *Aśvāyurveda*. Śukrācārya in his *Nītisāra* treated the subject in detail, and he is largely quoted in the commentary on the *Aśva-vaidyaka*. King Nala had a surname 'Aśvavit,' i.e., versed in the science of horse. Nakula and Sahadeva, the twin-sons of Mādrī, were taught by Droṇa in the art of training, managing and curing horses and cattle respectively. In the *Mahābhārata (Virāṭa-parva, Chapter 3)*, when the Pāṇḍavas entered into the services of King Virāṭa, Nakula declared himself well-versed in the science of management and treatment of horses, and Sahadeva referred to his scientific knowledge about the cows. To Nakula is ascribed the work called *Aśvacikitsā* or 'Treatment of Diseases of the Horse' which is still extant. This book is also called *Śālihotra*. It has been edited by Pandit Umeschandra Gupta Kaviratna and printed in the *Bibliotheca Indica*, as a supplement to the *Aśva-vaidyaka* by Jayadatta Sūri in 1887. Reference is also made in the *Aśvalakṣaṇa-śāstra* to a big treatise on the subject by Siṃhadatta. Vātsya was another sage, versed in the veterinary science. Jayadeva also wrote on the treatment of horses and he is quoted by Jayadatta. Mallinātha Sūri has quoted verses from *Hayalīlāvatī*. Bhoja was a writer on the same subject *(Vāji cikitsā)*, but no such work of his is known to scholars. In *Yuktikalpataru*, draught and other animals are described by King Bhoja. This book has been printed in the *Calcutta Oriental Series*. There is another work *Aśvavaidya-śāstra* by Dīpaṅkara. In *Kavi-kalpalatā* we find some descriptions of horses, and in *Basantarāja* (13th varga), prognostications are indicated from the characteristics of horses *(Haya Śakuna)*. Sāraṅgadhara is the author of

Turaṅga-parīkṣā and *Vāji-cikitsā*. Even as late as 1812, King Indusena wrote his *Sārasaṃgraha*, a short treatise on veterinary medicine, based on Śāilhotra's work. *Manapriyamatam* is a book on the characteristics of good and bad horses with hints for ascertaining their age, etc.

Pālakāpya expounded the science of treatment of elephants. He lectured on this science—*Gajāyurveda* or *Hasti-āyurveda*—to King Romapāda, the contemporary of King Daśaratha of Ayodhyā. This work has been edited and published in the *Anandasrama Sanskrit Series*, Poona. Another book on the 'Treatment of Elephants' is quoted by al-Bīrūni (see Sachau's *Preface to Indica*, p. xi). *Gaja-nirūpaṇa*, *Mātaṅga-līlā* (published in the *Trivandrum Sanskrit Series)* and *Gaja-cikitsā* are other works on the subject. The topic also finds a place in the various Purāṇas, e.g., *Agni-purāṇa* (chs. 289-91), and in Kauṭilya's *Arthaśāstra* and Kāmandakī's *Nītisāra*. *Gajapaddhati* and *Aśvapaddhati* are chapters in the *Subhāṣitasudhānidhi*, an anthology compiled by Sāyaṇa.

The fifth chapter of the *Śyainika-śāstra*, a book on hawking by the royal poet Rudradeva of Kumaon *(Bib. Ind.)* is devoted to the considerations of the kind and quality of the hawk's food, their tending in different seasons, and the treatment of their diseases. In the *Tanjore Cat.*, lix, (12, 305) D, ff. 8, is noted *Aśvalakṣaṇa* said to be from the *Ākāśabhairava-tantra* and *Gaja-śanta* (12, 297) D. ff. 4 from *Ākāśabhairavāgama*.

In the literature of the Jains we find descriptions of vegetable kingdom and a comparison of the life-history of plants with that of man. It is said that the cultured women of the time were versed in the different kinds of sciences (72 in number), in the list of which, mention is made of the science of horsemanship, management of elephants, medicine, chemistry and *tarucikitsā* or 'Treatment of Trees.' The women were also proficient in the 64 *kalās* or arts which are enumerated, and in the list we find *Ārāmaropaṇa* (Gardening), *Gajaparīkṣā* (Examination of elephants), *Aśvaparīkṣā* (Examination of horses) and *Vaidyakriyā* (Practice of Medicine).

In Magadha, horses and elephants were used for war. Rhys

Davids remarks : "The testimony of Indian records ascribe the pre-eminence in the training of horses to the extreme north and west which then belonged to Magadha, and the pre-eminence in the training of elephants to the east, which is precisely Magadha. This use of elephants in war may have been an important factor in the gradual rise of Magadha to the supreme power."

That the Indians were proficient in horsemanship, we have the testimony of foreign writers on the subject, e.g., Megasthenes and Arrian. "The greatest proficients use their skill by driving a chariot round and round in a ring; and in truth it would be no trifling feat to control with ease a team of four high-mettled steed when whirling round in a circle."

The MS. is called *Śālihotra,* a work on veterinary medicine. Śālihotra is described to be the son of Hayaghoṣa, and the father of Suśruta, in answer to whose questions he expounded the *Haya Āyurveda* revealed to him by Brahmā himself. It is a work on the treatment of horses. It is a practical farriery, a complete guide to all that relates to the horse; its history, varieties, and uses; breaking, training, feeding, stabling, grooming; how to buy, keep and treat a horse in health and disease, etc., forming a complete system of veterinary art as practised in ancient India, and there it was accepted as the standard work on the subject. Śālihotra gives his name to the art, and to this day horse and cattle doctors are known in the North-West Provinces under the name of Saluter.

The other sections are not available. In the Monthly General Meeting of the Asiatic Society of Bengal held on the 4th March, 1925, H.P. Sastri showed us a valuable find of manuscript in the shape of the eighth *sthāna* of Śālihotra's work, the *Rahasya-sthāna,* from Udaipur in Rajputana. The MS. is in very good preservation and well-written. The manuscript is no doubt unique, but his opinion that this was the only part of Śālihotra's work known to exist, required modification, and when I pointed out the *I.O. MS.* and *Tanjore Cat. MS.*, the MSS. were afterwards verified by him. The MS. consists of 5,000 *ślokas* and is in the possession of MM. Sastri. Afterwards

I learned from him that with the instinct of a scholar he made a gift of the MS. to the Library of the Society and it is now available to scholars. The entire MS, of Śālihotra exists in Baroda and will be published soon. In the *Triennial Cat. MSS. Madras*, 1916-19, R. No. 2342, we find 1-18 chapters of the eighth section or *Rahasya-sthāna* and 1-9 chapters of *Unnaya-sthāna*.

Śālihotra is said to have lived in Śālātur, a country near Gāndhāra, the modern Kandahara. As such, he is identified with Paṇini by some, and with Dhanvantari by others (see Dr. Mitter's opinion in the *Proceedings of the A.S.B.*, July, 1835). Cunningham *(Ancient Geography of India*, pp. 57-58) identified Śālātur with modern Lahore(Salatur, Halatur, Aalatur,Lahore) but without sufficient evidence. Hiuen Tsang's 'Salatulo' which is situated at a distance of 20 *li* or about 3·5 miles in a north-western direction from the province of Ohinda corresponds to Śālātura, the birthplace of Pāṇini (Śālāturīya), in which designation he is referred to in the copperplate inscription of the Vallabhis found in Kathiward *(Indian Antiquary*, Vol. I, pp. 16, 17 and 45). According to Nakula he was the son of Hayaghoṣa or Turaṅgaghoṣa, which are merely descriptive synonymous names. He lived in Śrāvastī and was a Brāhmaṇa by caste.

He explained the science at his retreat in the forest of Campaka (the Campakābaṭī forest in Magadha Deśa) at the foot of the Himālaya mountain.

Hayaghoṣa or Turaṅgamaghoṣa is said to have been the father of Śālihotra. Hayaghoṣa has been identified with Aśvaghoṣa from the similarity in the names which are synonymous (*haya*=*aśva,* a horse). Hayaghoṣa may thus be identified with the celebrated Buddhist preacher and writer Aśvaghoṣa, the author of *Buddha-carita.* There is evidence to connect Aśvaghoṣa to the court of the renowned Indo-Scythian monarch Kaniṣka of Peshawar and so he must have flourished towards the end of the first century A.D.

Hayaghoṣa is also described to be a Brāhmaṇa Muni who had hermitage in the Campaka forest at the foot of the Himālaya mountain. Thus the age of Śālihotra may be known, but

neither Aśvaghoṣa nor Śālihotra has given us any clue as to their identity. Again Suśruta, to whom Śālihotra addressed his lectures, flourished long before Kaniṣka, unless by Suśruta is meant Nāgārjuna, the celebrated Buddhist chemist, the redactor of *Suśruta-saṃhitā*, who flourished during the second century A.D.

PĀLAKĀPYA

In the Hasti Āyurveda, Pālakāpya is described to be the son of Sāmagāyanākhya Muni by a female elephant which drank his urine containing his seminal discharges. He was invited by King Romapāda who wanted to subdue elephants for human use. Romapāda or Lomapāda was king of Campā, which has been identified by Cunningham with Pātharghāṭā, some 24 miles distant from the modern town of Bhagalpur. Romapāda was the father-in-law of Ṛṣyaśṛṅga Muni and was a contemporary of Daśaratha, father of Rāma. Fa-Hien describes Campā to be a large town containing many Buddhist Stūpas and Vihāras. Campā or Mālinī, the capital of the country of Aṅga, was called after king Campa, son of Pṛthulākṣa.

The author of *Trikāṇḍaśeṣa* identifies Pālakāpya with Dhanvantari, the founder of the Surgical School in India. Suśruta is said to have learned major surgery from Dhanvantari; but from other accounts we learn that Suśruta also learned the veterinary science from Dhanvantari. So if we accept them (Pālakāpya and Dhanvantari) to be identical persons, we get a solution of the difficulty. But the evidence of their identity is by no means complete, and is far from satisfactory.

Pālakāpya's work : Hasti Āyurveda or Pālakāpya. It is a voluminous work on elephants, describing in detail their diseases and treatment, both medical and surgical.

An analysis of the contents of the Pālakāpya has never appeared in the English language. Burnell in his *Catalogue of the Tanjore MSS.* refers to the work as *Gajavaidya* and says : "This name appears to be not very certain; it consists of dialogues between a king of Aṅga and a *muni* called Pālakāpya, who

is the offspring of a *Ṛṣi* and a pious female elephant. There is a great deal of mythological matter about the creation, the origin of elephants, who were originally winged, and were deprived of these appendages by the curse of an angry saint, who was pestered by their tumbling down on him from the trees round his hermitage, on which they used to perch in order to *graze* on the leaves. The rest refers to the points of animals, as usual, very fanciful : their castes and dispositions; the way of taming them; their diseases and the way of treating and curing them. The number of their diseases appears to be put at 106. There can be no doubt that this is a very modern compilation, even later than the *Sārasaṃgraha* (on horses). Some of the verses, however, which are found here, occur in *Śāraṅgadhara* as by Pālakāpya. See Aufrecht's paper in the Z.D.M.G., Vol. xxvii. pp. 1-120."

ĀTREYA PUNARVASU

Ātreya or the son of the sage Atri, is also called Punarvasu. We find three Ātreyas mentioned in the *Caraka-saṃhitā*—Ātreya Punarvasu, Kṛṣṇa Ātreya and Bhikṣu Ātreya. Punarvasu Ātreya is the speaker in the *Agniveśa-tantra* which was edited by Caraka.

Ātreya learned the science of medicine from Indra. He composed several works bearing his name, among which is the book called *Ātreya-saṃhitā*, in five parts, containing 46,500 verses in all. He is one of the oldest authorities on Hindu medicine, and several later writers have based their works on his treatise. His six disciples were Agniveśa, Bhela, Jatukarṇa, Parāśara, Kṣārapāṇi and Hārīta, all of whom distinguished themselves as authors of medical works. The *Agniveśa-tantra* as redacted by Caraka and Dṛḍhabala is the well-known *Caraka-saṃhitā*. The *Bhela-saṃhitā* is mentioned in the *Tanjore Catalogue*; it has been published by the University of Calcutta. The *Hārīta-saṃhitā* has also been printed. The works of Jatukarṇa, Parāśara and Kṣārapāṇi are not available now.

Formulae : 1. The Agni-clarified Butter, 2. Rājavallabha

Taila Ghṛtam, 3. Ardhamātrika Vasti, 4. Viṃśati Sārāsava, 5. Dādhika Ghṛta, 6. Mahāmāyūra Ghṛta, 7. Vṛhat Guḍucī Taila.

KṚṢṆA ĀTREYA

In the medical literature of the Hindus we find references to different Ātreyas : Punarvasu Ātreya, Kṛṣṇa Ātreya, Dattātreya and Bhikṣu Ātreya. In the *Caraka-saṃhitā* Punarvasu Ātreya appears to have taught the six disciples, Agniveśa and others; and in that book, his name is always written as Punarvasu Ātreya and never as Kṛṣṇa Ātreya. Bhikṣu Ātreya is the reputed teacher of Jīvaka, the famous physician of Buddha. We find from quotations from Kṛṣṇa Ātreya that he belonged to the surgical school and could not have been the same as the Punarvasu Ātreya, the speaker in the *Agniveśa-tantra*. Śrīkaṇṭhadatta in commenting on *Kavalādhikāra* (Vṛnda's *Siddhayoga)* says : *nanu ca tantrāntarīyaiḥ ṣaḍvidhaḥ kavalaḥ paṭhitaḥ* etc.; and again in the *Unmādādhikāra* : *ṣoḍaśaguṇaṃ cāmmaḥ kṛṣṇātreya* etc.

Frem these quotations we learn that Kṛṣṇa Ātreya was a surgeon.

In the *Tattva-candrikā*, Śivadāsa, while commenting on Daśamūlaṣaṭpala-ghṛta quoted from *Jvarādhikāra* of Cakradatta cites the names of Gopura Rakṣita, Jatukarṇa, Caraka, Suśruta and Kṛṣṇa Ātreya. This proves that Kṛṣṇa Ātreya's work was quite different from that of Caraka.

But there is a difficulty to be solved. Dṛḍhabala mentions *nāga-rādya-cūrṇa* in the treatment of Grahaṇī or Diarrhoea. This formula occurs also in *Cakradatta* and *Siddhayoga.* Both Śrīkaṇṭhadatta and Śivadāsa, from whose comments we have tried to prove before that Kṛṣṇa Ātreya was a surgeon and was a different author from Punarvasu Ātreya, in commenting on the line *nāgarādyamidaṃ cūrṇam* etc. distinctly states "Kṛṣṇātreyaḥ Punarvasuḥ." We cannot explain this identity satisfactorily. Kaviraja B.C. Gupta thinks that it is a mistake of the writers ! Kaviraja Umes Chandra Gupta, the author of *Vaidyka-*

śabda-sindhu, however, makes Kṛṣṇa Ātreya the teacher of Agniveśa. But Agniveśa was one of the six pupils of Punarvasu Ātreya.

Pandit Jogindranath Sen Vaidyaratna in his highly meritorious commentary in Sanskrit *Carakopaskāra* on the *Caraka-saṃhitā* tries to tide over the difficulty by assuming the name of Atri to be Kṛṣṇa Atri. Thus he explains Ātreya in i. 1, as 'Ātreya, the son of Kṛṣṇa Atri.' This no doubt reconciles the conflicting statements of commentators but makes Kṛṣṇa Ātreya and Ātreya Punarvasu to be the same Ṛṣi. But this conclusion is open to objections. Nowhere has he been so styled in the *Caraka-saṃhitā*. He has been quoted as an authority in surgery. In *Cakradatta*, the formula Kuṭaja Puṭapāka is, however, attributed to Kṛṣṇātri-putra or 'son of Kṛṣṇa Atri.' Moreover the assumption that Kṛṣṇa Atri is the progenitor of the Ātreyas requires proof which is not forthcoming.

Ātreya Punarvasu has been identified by some with Bhardvāja, but Cakrapāṇi in his *Āyurveda-dīpikā* distinctly states that this theory of some commentators is untenable as Ātreya has never been styled Bharadvāja anywhere in the medical texts (p. 7, i. 1.). In the list of the sages who met to learn Āyurveda, Ātreya and Bharadvāja are seperately mentioned. This theory perhaps had its origin in the diversity of opinion as regards the relation of the two sages. In the *Caraka-saṃhitā* i. 1., Bharadvāja, the disciple of Indra, is the teacher of Ātreya Punarvasu. Cakrapāṇi notes that Hārīta was of the same opinion. Vāgbhaṭa on the other hand describes Ātreya as the disciple of Indra. Bhāva Miśra describes both Ātreya and Bharadvāja as disciples of Indra.

Formulae attributed to Kṛṣṇa Ātreya :

1. Kuṭaja Puṭapāka, 2. Nāgarādya-cūrṇa, 3. Vijaya-cūrṇa, 4. Śatāvarī oil, 5. Caturmukha, 6. Kaduka-ghṛta, 7. Mahāgaurādya-ghṛta, 8. Rohītaka-ghṛta, 9. Gauryādya-ghṛta, 10. Vindu-ghṛta, 11. Mahāvindu-ghṛta, 12. Abhayādyavaṭaka, 13. Aṣṭacatvāriṃśa-guggula-guṭika, 14. Guḍa Kusmāṇḍa,

15. Khadirāsava, 16. Dvātriṃśaka-kvātha, or Rāsnādi-kvātha, 17. Candanādya powder, 18. Nārāyaṇa oil, 19. Oil for diseases of head, 20. Yogendra Rasa.

KĀPYA

In the *Caraka-saṃhitā* he is styled as Bhadra Kāpya or Kāpya the Noble. He refutes the arguments of Śaunaka that the diseases are caused by hereditary transmission and says : "No that cannot be; the offspring of a blind father is not necessarily blind, so the parents cannot be said to have originated the body and its diseases. The man and his diseases owe their origin to his own works in a previous birth" (i. 25)·

He is mentioned as one of the sages present at a meeting of the Ṛṣis as narrated in the *Caraka-saṃhitā* i. 26 ; the chapter is called *Ātreya Bhadra Kāpīya.* A discussion about Taste and Food was the result. Bhadra Kāpya says : "There is surely a single taste or *rasa* only. This *rasa* is only recognisable by tongue, and the wise consider it to be one of the objects—*rūpa, rasa* etc. This *rasa* or taste is nothing but water."

In the same chapter he expresses himself again on the incompatibility of fish and milk as articles of dietary; he allows all the fishes except the Cilcima, which, he says, if eaten may cause diseases, and sometimes even death. (*Caraka-saṃhitā*, i. 26). As regards the question of the part of the foetus first formed, he says : "The navel is the part which appears first, for this is the part where nutriment from the mother enters the body of the foetus" (*Caraka-saṃhitā* iv. 6).

This opinion has been ascribed to Parāśara in the *Suśruta-saṃhitā*, iv. 3.

KĀṄKĀYANA

Kāṅkāyana is the name of an ancient physician who is referred to in the *Caraka-saṃhitā* i. 26 as the foremost among the Vaidyas of Bālhīka or Balkh. He is there represented as having held with Nimi and other physicians a discussion on

the number of *rasa* or tastes. He was of opinion that the tastes were innumerable and that they could only be described according to their seat, quantity and mode of action.

He is also referred to in the *Caraka-saṃhitā* i. 25 as contradicting the opinion of Kumarāśirā Bharadvāja about the origin of diseases and as having held the view that Brahmā, the creator, is the cause of ease and disease.

He is named in the *Cāraka-saṃhitā* i. 1 in a list which contains the names of a number of other ancient physicians. His opinion is also quoted in the same book iv. 6 as regards the part of the foetus formed first. His opinion is : "The heart being the seat of life and consciousness is the part formed first." But in the *Suśtrua-saṃhitā.* iii. 3, the same view is ascribed to Kṛtabīrya.

The ancient physician Kāṅkāyana is probably the Kankah or Katka of the Arabs (see Reinaud, *Mem. Sur l'Inde,* p. 314 ff), who is expressly termed Vāhlīka-bhiṣaja. His name appears amongst the teachers of the *Atharvapariśiṣṭa*-s.

Formulae attributed to Kāṅkāyana : 1. Prescription of a purgative for bilious subjects, 2. Kāṅkāyana Modaka, 3. Kāṅkāyana-guṭikā, 4. Kāṅkāyana-vaṭaka.

KAṆĀDA

Kaṇāda, the famous sage who propounded the Vaiśeṣika system of philosophy, is said to have written a treatise on *Pulse* consisting of 63 stanzas. It is known as *Nāḍī-vijñāna.* He is said to have written a more comprehensive work, the *Kaṇāda-saṃhitā*—a treatise on pathology and medicine, of which the chapter on pulse—the *Nāḍī-vijñāna*—only is extant. It forms the first chapter and is also called *Paribhāṣā.* The pulse is treated as an index to disease and its indications may imply approaching death. The Vaidyas rely principally on pulse and they diagnose diseases by the character of the pulse.

The book has been printed with *Nāḍi-prakāśa* of Śaṅkara Sena by Nandalal Vidyaratna Kaviranjana, Calcutta, 1887.

THE BOWER MANUSCRIPT

A. F. R. HOERNLE

I. THE DISCOVERY OF THE BOWER MANUSCRIPT

The *Bower Manuscript,* which is named after its discoverer, Lieutenant (now Major-General) H. Bower, C.B., fell into the hands of that officer, early in the year 1890, in Kuchar, where he had gone, on a confidential mission from the Government of India, in quest of the murderer of Dalgleish.

Kuchar, or Kucha, situated about 41° 42′ 50″ N. Lat., and 80° 33′ 50″ E. Long., is the name of one of the principal oases and settlements of Eastern Turkestan, on the great caravan route to China, which skirts the foot of the Tian Shan Range of mountains on the northern edge of the Takla Makan desert.

On his return to India, Lieutenant Bower took the manuscript to Simla, whence in September 1890 he forwarded it to Colonel (now Major-General) J. Waterhouse, who was then the President of the Asiatic Society of Bengal. By him it was exhibited to the Society at their monthly meeting on the 5th November 1890, when also a short note from Lieutenant Bower, dated the 30th September 1890,was read explaining the circumstances of the discovery. Some attempts were made after the meeting to decipher the maunscript, but they proved unsuccessful. At the time I was absent on furlough to Europe. It was on my return voyage to India that I received the first news of the discovery through a copy of the *Bombay Gazette* which fell into my hands at Aden. By a lucky chance, Major (now Major-General) W. B. Cumberland whose companion Lieutenant Bower had been during the earlier part of his travels, happened to be a fellow passenger on the steamer, and furnished me with corroborative information. On reaching Calcutta in February 1891, being then the Philological Secretary of the Asiatic Society of Bengal, I at once claimed the manuscript from Colonel Waterhouse, who most readily made it over to me. At the April meeting of that year, I was able to communicate to the

Society the first decipherment of the manuscript which was immediately published in its *Proceedings* (April, 1891), pp. 54-65.

It was the discovery of the *Bower Manuscript* and its publication in Calcutta which started the whole modern movement of the archæological exploration of Eastern Turkestan. The late Hofrat Professor G. Bühler, having seen the report of the discovery in the *Proceedings* of the Asiatic Society of Bengal, at once announced it in an early issue of the *Vienna Oriental Journal* for 1891, p. 103. The Russian Archæological Society, having thus their attention attracted, addressed, in November 1891, a request to Mr. Petrovski, the Russian Consul General in Kashgar, to endeavour to collect similar manuscript treasures. In response to it the Petrovski Collection went to the Imperial Library in St. Petersburg, in the autumn and winter of 1892-3, of which Professor Serge d'Oldendurg published a report and specimens in the *Transactions* of the Imperial Russian Archæological Society, Vol. viii, for 1893-4, pp. 47 ff. In the same year, 1892, the Weber Collection of manuscripts was acquired by the Rev. F. Weber, Moravian Missionary in Leh, whose curiosity had been aroused through a meeting with Lieutenant Bower on the latter's return journey to India. This acquisition was at once transmitted to me, and a report and specimens were published by me in the *Journal* of the Asiatic Society of Bengal, Vol. lxii of 1893, pp. 1 ff. In the following year, 1893, on my motion, the Government of India issued instructions to their Political Agents in Kashmir, Ladak, and Kāshgar, to make enquiries for ancient manuscripts, and secure all that might come in their way. It was in pursuance of these instructions that the "three Further Collections" of manuscripts came into my hands, of which a report and specimens were published by me in the *Journal* of the Asiatic Society of Bengal, Vol. lxvi, of 1897, pp. 213 ff. The most important, in the present connection, of these three collections are the Macartney manuscripts, so named after Mr. G. Macartney, the British Consul in Kāshgar, who secured them in 1895.

The direct result of these discoveries of ancient manuscripts was the inception of the first expedition of Dr. M. A. Stein into

Eastern (or Chinese) Turkestan in 1900-1901, of which a part was published by him, in 1902, in his *Ancient Khotan* in two volumes. It is true that there had been numerous expeditions into that country in earlier years, such, *e.g.*, as the Russian expedition of General Prejevalski in 1878 and 1885, the British expedition of Major (now Lieut.-Colonel) Sir Francis E. Younghusband, K.C.I.E., in 1887-90, the French expedition of M. Dutreuil de Rhins in 1891-2, and the Swedish expedition of Dr. (now Sir) Sven Hedin K.C.I.E. in 1894-7, but none of these was undertaken with the object of archæological exploration. Their main object was scientific, *i.e.*, geographical, geological, zoological, and the like, and any antiquities which they brought home had been gathered, as it were, accidentally and by the way. The first expedition to Eastern Turkestan which was undertaken avowedly for the purpose of exploring the country archæologically, and excavating ancient sites, was the Russian of M. D. Klementz in 1898. As in the case of the expedition of Dr. Stein, it owed its inception directly to the stimulus imparted originally by the discovery of the *Bower Manuscript.* A series of archæological expeditions now followed in rapid succession. It comprised the first German expedition, led by Professor Grünwedel, in 1902-3 ; a Japanese expedition, in 1902-3, under Count Otani ; the second German (or first Prussian) expedition, under Dr. A. von LeCoq, in 1904-7 ; and the second Prussian expedition led again by Professor Grünwedel, in 1905-7. These were followed, in 1906-8, by the second British expedition of Dr. Stein, which was extraordinarily successful, and fruitful of archæological results, and of which a preliminary account was published in the *Geographical Journal* (for July and September) 1909. The last of the series was the French expedition, under M. Paul Pelliot in 1907, which has recently (autumn 1909) returned to Europe. As it made a particular point of thoroughly exploring the district of Kuchar, where the *Bower Manuscript* was found, its full and final report when it appears may be hoped to set at rest any still remaining doubts regarding the exact locality and time of its discovery.

In the meantime the publication of the *Bower Manuscript* steadily pursued its course. The proposal to prepare a complete edition of its text, illustrated with facsimile Plates, and accompanied by an annotated English translation, was accorded, in 1892, the sanction of the Government of India, through the cordial support of Sir Charles Elliott, the then Lieutenant-Governor of Bengal. The First Part of the edition appeared in 1893; the Second Part (in two fasciculi) in 1894-5, and the remaining Parts III to VII in 1897. This completed the edition of the text and translation. After an interruption of several years, caused by my retirement from India and engagement in other time-absorbing work on subsequent finds of ancient Central Asian Manuscripts, the Sanskrit Index, being a complete vocabulary of the *Bower Manuscript*, was published in 1908, and a Revised translation of its medical portions, in Parts I, II and III, in 1909. The Introduction, benefiting by the long delay and the attendant material increase of information, now brings the laborious work of the edition to its long-desired completion.

The *Bower Manuscript* itself, which till the completion of the edition of the text in 1897 had remained in the hands of the editor, was returned, in April 1898, to its owner, Colonel Bower. By him it was taken to England, where it was finally purchased, in 1898, by its present possessor, the Bodleian Library in Oxford...

II. DESCRIPTION OF THE BOWER MANUSCRIPT

The term *Bower Manuscript* is not strictly correct. As will be seen from the sequel, the object in question is not really a single manuscript, but in point of size, rather a combination of two manuscripts, a larger and a smaller. The larger manuscript itself, moreover, in point of subject matter is a complex of six smaller manuscripts, the distinction of which from one another is indicated also by their separate pagination. The *Bower Manuscript*, therefore, in reality is a collection of seven distinct manuscripts, or it may be called a collective maunscript of seven parts. The latter is the terminology adopted in the

present edition; that is, Parts I-III, IV, V and VII, constitute the larger manuscript, while the smaller manuscript consists of Part VI.

The external form of the collective *Bower Manuscript* is that of the Indian *pothī*. A *pothī* consists of a number of leaves, of a practically uniform oblong shape, generally enclosed between two wooden boards, and the whole held in position, or "bound" by a string which passes through a hole drilled through the the whole pile....

The leaves of the *Bower Manuscript* are cut from the bark, or periderm, of the birch tree; those of a modern Indian *pothī* are, as a rule, of paper. Before the introduction of paper into India, which event probably coincided with the advent of the Muhammadans, the writing material for the purpose of literature was palm-leaf or birch-bark. Palm-leaf must have been the original material of an Indian *pothī*; for it was the shape of the palm-leaf which determined the narrow oblong shape of the leaves of the *pothī*. The bark of the birch tree may be obtained in very large strips, about a yard long and eight inches broad. There is no apparent reason why these strips should have been cut into narrow oblong pieces in order to be used as the writing material of books. On the other hand, from the long narrow segments of the leaf of a palm tree none but strips, at most about a yard long and three inches broad, could be cut. These, if used as writing material, necessarily determined the narrow oblong shape of the leaves of the *pothī*. The birch tree *(Betula utilis)* the "Himalayan Birch," is indigenous in the extreme North of India (*e.g.*, in Kashmir), while the palm tree (Talipat, *Corypha umbraculifera)* is peculiar to the South of India. Hence the fashion of the Indian *pothī* must have originated in the South of India, while the original "book" of the North of India must have been written on large strips of birch-bark. As a fact the oldest Indian "book" on birch-bark, the *Dutreuil de Rhins Manuscript*, which probably dates from near the beginning of our era, is written on such large strips. The Southern Indian fashion of the *pothī* is, in many ways, more convenient for literary use; and as evidenced by the *Bower Manuscript* and by the other birch-

bark manuscripts which have been discovered in Eastern Turkestan, it must, at a very early period, have made its way into Northern India, whence finally it was carried, by the spread of Buddhism, to Eastern Turkestan, nearly all the indigenous paper manuscripts of which exhibit the narrow oblong shape of the Indian *pothī*. At a much later period, probably after the advent of Islam and its western culture, the fashion arose, within the birch-bark area of Northern India to use birch-bark in imitation of paper, and to give to birch-bark books the shape of the paper books of the West. The Indian *pothī* shape of the birch-bark *Bower Manuscript*, therefore, is corroborative evidence of the great antiquity of that manuscript.

The birch-bark leaves of the *Bower Manuscript*, as already intimated, are of two different sizes. The leaves of Parts I-III, IV, V, and VII are considerably larger, both in length and breadth, than those of Part VI. The former measure about 11·5 by 2·5 inches; the latter, about 9 by 2 inches. Besides the size of the leaves, there is another point which differentiates the two portions of the collective manuscript from each other. The birch-bark of the larger portion is of a quality much inferior to that of the smaller portion (Part VI). The former is hard and brittle, and apt to break if roughly handled; while the latter is soft and tough and can readily be bent. The difference may be due to the age of the tree from which the bark was taken, as well as to the thoroughness of the process (probably boiling in milk or water) by which the bark was prepared for the reception of writing. Moreover, some of the leaves used in the larger portion were in a defective condition at the time when they were inscribed, while the leaves of Part VI were, and are still, in perfect order. For example, in Part I a large portion in the upper right corner of the third folio, affecting no less than six lines, had broken away, before the leaf was inscribed; for nothing of the text is wanting. Similarly, in Part II, large holes had broken into folios 25 and 26, before they were written on. On the other hand, the defects in folios 9 and 12 of the

same Part only occurred after those leaves had been inscribed ; for some portion of the text is lost. But there is also another cause to which the defective condition of the leaf is occasionally due, *viz.*, exfoliation. Birch-bark, as writing material, is of varying thickness, consisting of several layers of periderm of extreme tenuity, numbering from two to twelve, or even more : one layer by itself would be too tenuous to be inscribed. When the bark is properly prepared, the process renders the natural adhesion of the layers more durable; but when it is imperfectly prepared, or when it is taken from a too old tree, or from an unsuitable part of the tree, the surface layers are apt to flake off, when the bark becomes thoroughly dry. In that condition, a leaf is unsuitable for writing. This may be illustrated by the blank reverse of the fourth folio in Part IV, which distinctly shows the surface in process of exfoliation; and it was, no doubt, for that reason that the scribe abstained from writing on it. For the same reason, apparently, the obverse of the fourth folio of Part V was left blank. On the other hand, occasionally exfoliation took place after the leaf had been inscribed. Thus on the left of the reverse side of the thirty-third folio of Part II, about one-fourth of the surface layer has flaked off, carrying with it a large portion of the text; the same injury has befallen a smaller portion of the reverse of the twentyninth folio. On the obverse side of the sixth folio of Part V we have another example of the same phenomenon; and in the case of folio 1 of Part VII the whole of the inscribed top layer of the obverse side has flaked off. In the third place, much of the bark, used in the larger portion, is full of faults in its texture. It appears to have been taken from an unsuitable part of the tree,producing a rough and knotty surface, unserviceable for writing. This may be seen by reference, *e.g.*, to the reverses of the first folio of Part II and the second folio of Part IV about one-half of which has been left blank. It is also illustrated by the fact that sometimes when the scribe attempted to write across a fault, his letters would form only very badly, as, *e.g.*, in Part I, folio 5*b*, where the syllable *lā* (of *elā*) is almost illegible ; or they would not form at all, and the writer was obliged to abandon a half

finished letter, and trace it anew on the other side of the fault, thus leaving a more or less extended gap in his line. Thus in Part I, folio 3*a* we have *vimi* [*śa*] *śro*, folio 3*b*, *jī*[*va*] *vitukāmaḥ*, folio 5*b* (Plate V), *vya*[*va*]*vāyācca*, where the abandoned half-finished letters are indicated by being placed within brackets (*Journal*, As Soc. Beng., 1891, Vol. lx, Part I, p. 137). Other examples are in Part II, fols. 7, 8, 22, 27, 29, etc. in Part III, folio 3, and in Part V, folios 2 and 6, which show large un-inscribed places. None of these defects is seen in the bark of Part VI, which is of the proper texture, and has been properly prepared.

The fact of the larger portion of the *Bower Manuscript* being written on birch-bark of such an inferior quality, of course, suggests the enquiry as to what may have been the cause of it. So much seems obvious that, as Kashmir and Udyāna are the lands of the birch and birch-bark, the scribes of the larger portion of the *Bower Manuscript* would not have had recourse to an inferior quality of bark, if at the time of writing it, they had not been, for some reason, in a position which made it impracticable for them to procure a supply of good bark. The most obvious explanation that suggests itself, of course, is that when they wrote their manus-cript, they were already settled in Kuchar, where fresh birch-bark prepared for writing was not readily procurable, for which reason they were reduced to the necessity of using up what inferior portion remained to them of the store of birch-bark which they may have originally brought with them from their home in north-western India. But by the time that Part VI came to be written, a fresh supply of good and well-prepared bark had been procured.

One of the indications of the collective character of the *Bower Manuscript*, as has been stated, is the mode of pagination which it exhibits. For the leaves of each Part are numbered separately, so far as can be judged from the numbering where it is preserved. In Indian *pothī*-s the practice is to number, not the pages, but the leaves ; and the numbers are placed on the left hand margin, either on the obverse or the reverse side

of the leaf. In northern Indian manuscripts it is always the reverse side which is thus numbered, while in southern manuscripts, it is the obverse. In Parts IV and V, the margins are so imperfectly preserved that it must remain uncertain whether they ever bore any numbers. The practice of numbering the folios, however, is so general in Indian manuscripts that, on the whole, the probability is in favour of its having once existed in those Parts at the time when the margins were entire. In Parts I—III and VII the margins of most leaves are fairly well preserved, and they show the usual pagination on the reverse side of the leaf, thus pointing to a northern locality as their place of origin. Part VI, the margins of which are well preserved, shows pagination throughout ; and, what is noticeable, the numbers are on the obverse side of the leaves. That fact points to a southern place of origin, and this indication is confirmed by others.

The total of the existing leaves of the *Bower Manuscript* is fifty-one. But unfortunately the more important portion of it, Parts I—III, which treats of medicine, is incomplete. Part I ends quite abruptly with the fifth folio. How many more may have completed the text, it is impossible to conjecture from the context. The existing five leaves are numbered consecutively from 1 to 5. The obverse of the first leaf, as usual in Indian *pothī*-s, is left blank. In the left-hand margin of the reverse of the third leaf, there appear, below the ordinary pagination 3, two other signs of doubtful value. If they are to be read as separate numeral figures, they might be 51; or if they are to be read as a single figure, it might be an imperfectly (*i.e.*, discontinuously) written 40 or 70. But in either case their purport is a puzzle. Part II also is a fragment; for it ends, apparently abruptly, with the 33rd folio somewhere in the fourteenth chapter. Moreover, the two final chapters, the fifteenth and sixteenth, which are announced in the introduction (verses 8 and 9, p. 77) are entirely missing. In addition, the entire folios 20, 21 and 30, and the major portion of folios 16 and 17 are missing. Also, as previously stated, smaller portions are missing, by fracture in folios 9 and 12, and by

exfoliation in the reverses of folios 29 and 33. The total number of the existing leaves, inclusive of the two fragmentary folios 16 and 17, is thirty. In the case of most of these existing leaves, *viz.*, in folios 2-10, 12, 13, 15, 22-26, 31 and 32 (total 19), the ordinary pagination is fully preserved. It is only partially preserved in the five folios 16, 18, 19, 28, 29; and it is entirely lost, by fracture or exfoliation of the margin, in the six folios 1, 11, 14, 17, 27, 33. On folio 13 there is an indistinct mark between the figures for 10 and 3, apparently the cancellation of another wrongly inscribed figure. The pagination is placed as a rule, in the middle of the margin, but in folios 25, 31, 32 it appears in the top of the margin, facing the third or fourth line of the text; and it must have occupied the same position on folios 1, 11, 27, where the top of the margin is mutilated.

Part III, again, is a mere fragment. Its commencement is marked, as usual, by the sacred symbol of *oṃ* on the obverse of the first leaf; but it breaks off abruptly on the obverse of the fourth leaf. But the noteworthy circumstance is that it breaks off, not at the bottom, but in the middle of that side of the leaf. This circumstance certainly suggests that the original scribe left off writing at that point, and never completed his work. Subsequently, the manuscript came into the possession of the writers of Part IV, who commenced the writing of that Part on what was then the blank reverse of the fourth folio of Part III. Ultimately the whole manuscript, that is, the unfinished Part III and the subsequently added Part IV, came into the possession of a third person, *viz.*, the writer of Parts V and VII, who proceeded to write a remark of his own on the space left blank by the original writer on the lower portion of the obverse side of the fourth folio of Part III. This curious case will be the subject of further consideration with additional details, where it will be shown that the writer of Part III must have written also Part I and II. In connection with this latter circumstance the query suggests itself whether Parts I and II, no less than Part III, might not have been incomplete at the time when Part III came into the possession of the writer of

Parts V-VIII ; that is to say, that already at that time Parts I and II extended no further than they do at present. It might be surmised that the scribe who made the copies of Parts I-III died before he had finished his task, and that his unfinished copies passed on, in turn, to the writers, or owners, of Part IV and Parts V and VII. There is nothing in the Parts concerned to decide one way or the other about this hypothesis, but in any case the hypothesis has no concern whatever with the losses of fols. 21, 22 and 30 of Part II, or the fractures (*e.g.*, of fols. 16 and 17) and exfoliations which have been referred to. For injuries of an exactly similar kind are observable in every one of the Parts of *Bower Manuscript*, with the exception of Part VI which is written on birch-bark of a superior and durable quality. All these injuries occurred at a date subsequent to the hypothetical transmission of Parts I and II to its later owners. The second of the four folios of Part III is the only one which bears pagination. In the others the margin is defective.

Of Parts IV and V, which are two tracts on divination, the former is practically complete, while the latter seems to be considerably defective. Neither of them shows any pagination. As they are very small manuscripts, of five (strictly four and a half) and six folios respectively, it is possible that they never had any; but as the margins are more or less defective, the numbers may be lost; and this alternative seems more probable. The obverse of the first leaf of Part V is blank, just as in the case of Part I. Its reverse is inscribed only with the introduction to the treatise, which does not cover the whole of its surface. It bears only five lines, and there is a blank space left, sufficient for, at least, one additional line : all the other leaves have six or seven lines to the page.

Part VI, which is a treatise on a charm against snake bite, is complete. Being written on a superior quality of birch-bark, it is the best preserved portion of the *Bower Manuscript*. The left-hand margins of all its four folios are in good condition, and bear the pagination, 1 to 4, on the obverse sides. The manuscript commences with the usual symbol for *oṃ* on the

obverse of the first leaf, and ends with the usual Buddhist terminal salutations and the double stroke on the top of the reverse of the fourth folio.

Part VII, which contains a portion of the same charm against snake bite is defective. It consists of two, much damaged, leaves, the first of which, on its reverse side, bears the pagination 1. The obverse has lost its inscribed surface layer of bark and with it the commencement of the charm. The pagination of the second leaf is lost with the broken-off margin.

Indian manuscripts, or records, as a rule, commence with some benedictory word such as *siddham*, success, or *svasti*, hail, or with the sacred particle *oṃ*. The last mentioned is almost universally used at the present day. It may be either written in full, or indicated by a symbol. The latter takes the form of a spiral which may turn either to the right or the left and which is probably a conventional representation of the sacred *śaṅkha* or conch shell.

...In Parts V and VII it is lost through the damage suffered by their first folios. In all the parts, except the second, the symbol occupies the usual position facing the first line of the text ; but in Part II it appears in the more unusual position, on the left-hand margin, opposite the third line of writing, exactly as it is seen in the two copper-plate grands of Ananta Varman, dateable probably in the sixth century A.D., shown in Dr. Fleet's *Gupta Inscriptions*, pp. 220 and 226, Plates xxx*b* and xxxi*a*. Among the dated northern Indian epigraphical records of the Gupta period, the earliest known examples of the dextrorse form of the symbol are those of the year 448-9 A.D. in a stone inscription of Kumara Gupta I, and of the year 493-4 A.D. in a copper-plate grant of Jayanātha. The earliest known example of the sinistrorse form occurs in a copper-plate grant of Mahā-sadevarāja, of an unknown though early date, and apparently, though mutilated, also in the Bodhgayā inscriptions, of 588 A.D. Of course, these dates are not sufficiently numerous to settle the exact beginning and end of the period of the use of the two forms ; but on the whole the

sinistrorse form seems to be somewhat later in origin. Curiously enough, the symbol for *om*, in its dextrorse form, is found also on the obverse side of the 32nd leaf of Part II, on the left margin, opposite the second line of writing. How it comes to be there is, at present, not apparent.

As already observed, the typical Indian *pothī* is provided with a hole for the passage of the binding string. At the present day, the hole is placed exactly in the middle of the leaves; and it has been so during many centuries past. In the *Bower Manuscript* the hole is placed in the left side, about the middle of the left half of the leaf; about 3·25 inches from the left margin of the larger, and 2·25 inches, in the case of the smaller folios. There are reasons to believe that the latter practice was that which prevailed in ancient India. In the old Indian copper-plate grants, the copper leaves are strung together on a copper ring which passes through a hole in the left side of the leaves. The oldest known copper-plates of this kind are those of the Koṇḍamudi grant of Jayavarman (*Epigraphia Indica*, Vol. vi, p. 316) and the Pallava grants of King Śivaskanda Varman (*ibid.*, Vol i, pp. 4-6, 397; Vol. vi p. 84), which, on Palæographic and linguistic grounds, must be referred to the second and third centuries A. D. respectively. They have their ring-hole near the middle of the left half-side. They are all South Indian grants; and seeing that, as already pointed out, the oblong form of the earliest birch-bark *pothī*-s of Northern India, as seen in the *Bower Manuscript*, is an imitation of the palm-leaf *pothī* of Southern India.

It may be concluded that the placement of the string-hole in southern manuscript *pothī*-s was the same as in the southern copper-plate grants, and that the practice of placing the string-hole in the middle of the left half of the manuscript was adopted by the northern scribes from their southern brethren, whom, in fact, they imitated in the whole mode of fashioning the *pothī*. All the earliest birch-bark manuscripts of the fourth and fifth centuries show their string-hole on the left side. But as birch-bark (as well as palm-leaf) is a more or less fragile material, the practice soon arose for the greater safety of the leaves, to

make two holes, in the right and left halves, at corresponding distances from the right and left margins. The earliest known examples of this practice are presented in the *Horiuzi Manuscript* (see *Anecdota Oxoniensia*, Vol. I, Part iii, Plate I) and the two Nepalese manuscripts of the Cambridge Collection, Nos. 1702 and 1409 (see Bendall's *Catalogue*, Plate I, Figs. 1 and 2), all of which probably belong to the sixth century. Still later, the practice arose of replacing the two holes by one hole in the middle of the leaves. The existence of this practice is recorded by al-Bīrūnī in the eleventh century, who says (Professor Sachau's Translation of *Al-beruni's India*, Vol. I, p. 176) that "the Indians bind a book of palm leaves together by a cord on which they are arranged, the cord going through all the leaves by a hole in the middle of each." The hole was not at first in the exact middle, but—probably a modified survival of the ancient practice—slightly more to the left, as seen, *e.g.*, in the Nepalese manuscript No. xxi (Palæographic Society), which is dated in 1015 A.D. Still later, and in the present day, the hole appears in the exact middle of the leaves. The peculiar position of the string-hole, in the middle of the left side of the *Bower Manuscript*, therefore, is an evidence making for the extreme antiquity of the manuscript.

Unfortunately it has never been recorded in what condition the *Bower Manuscript* was when it was received by Colonel Waterhouse in Calcutta in September 1890. When it came into my hands in February 1891, the leaves of the *pothī* were enclosed between its two wooden boards, and a string run through them. In order to examine the leaves, I cut the string, and, on doing so, discovered that they were not arranged in their proper order, but that the leaves of the several parts were mixed up (see *Proceedings*, Asiatic Society of Bengal, 1891, p. 55). How they come into this state of disorder is not known. It does not seem probable that they were so originally when the manuscript was discovered by its Kuchari finders. The people who enshrined it in its receptacle in the stūpa may be

assumed to have been able to read it; and they would not have enshrined it in a disorderly condition. But from the time of its discovery, it passed through the hands of, at least, four different persons, all of whom may be assumed with certainty to have cut or unloosed the string to satisfy their curiosity, and none of whom knew, or could read the characters. In the case of Babu Sarat Chandra Das this is certain; for he stated himself to Colonel Waterhouse who had first given him the manuscript to examine, that he had failed to decipher it (see *Proceedings*, As. Soc. Beng., 1890, pp. 222-3). Moreover two of leaves were photographed (see *ibid.*, Plate iii) by Colonel Waterhouse, before ever the manuscript came into my hands. It may, therefore, be concluded with good reason that the disorderly condition of the manuscript arose only in the course of its passage through the several hands; and it seems not at all improbable that the serious damage done to the folios 16 and 17 of Part II may be due to incautious handling by the original Turki finders in Kuchar. After each examination the leaves seem to have bound together again by a string, whether the same original string or any other may be doubtful. That they were in this bound condition when they reached the hands of Colonel Waterhouse seems to be expressly stated in the original report, published in the November *Proceedings* of the Asiatic Society of Bengal (1890, p. 223).

III. THE SCRIPT, THE SCRIBES AND THEIR USAGES

...The results of the foregoing enquiry (mainly palæographical, *Ed)* may be summed up as follows. The writers of Parts I-III and Parts V-VII were natives of India who had migrated to Kuchar. They, no doubt, were Buddhist monks, and these, as is well known, were often in the habit of travelling, or migrating, for missionary or other purposes, into Foreign Parts. To judge from their style of writing, the scribe of Parts I-III originally came from the northern, and the two scribes of Parts V-VII from the southern part of the northern area of the Indian Gupta script. But the fact that they use birch-bark as

their writing material shows that the country, from which more immediately they migrated to Kuchar, must have been Kashmir or Udyāna; and the quality of the birch-bark which they use suggests that they wrote their respective parts of the *Bower Manuscripts* after their settlement in Kuchar, when their store of birch-bark had run short. Parts V and VII probably were written about the same time as Parts I-III. The latter apparently were never completed. They passed, in their incomplete state, into the hands of the writer of Part IV, who would seem to have been a native of Eastern Turkestan, or perhaps of China. From him Parts I-IV passed into the hands of the writer of Parts V and VII. PartVI was written at a subsequent date by a fourth scribe on a fresh supply of well prepared birch-bark leaves, since received from India, for the purpose of repairing the damage suffered, in the mean time, by Part VII. In fact, that fresh supply may have been brought from India by the fourth scribe himself who may have been a later immigrant. All four writers must have been residing in a monastery near Kuchar. But the ultimate owner of the whole series of manuscripts, whose name appears to have been Yaśomitra, must have held a prominent position in that monastery. For his collective manuscript was contained in the relic chamber of the memorial stūpa at the *Ming-oi* of Qum Turā, which would appear to have been built in his honour.

IV. SUBJECT AND CONTENTS OF THE TREATISES

(1) In the existing fragmentary state of Part I, it is difficult to determine the particular class of medical literature to which the treatise contained in it should be assigned. It commences with a *kalpa*, or small pharmacographic tract, on garlic (*Allium sativum*, Linn.). This tract consists of the initial forty-three verses, including between them eighteen or nineteen different, mostly more or less unusual, metres. Their list shows that the most frequent among them is the *vasanta-tilaka* with eight verses, while the well-known *śloka* comes only second with six verses. The tract is preserved in almost perfect order; the end of every

verse (except two, vv. 29 and 35) is marked with a double stroke. The concluding verse 43 alone is seriously mutilated, but fortunately its statement as to garlic *(laśuna)* being the subject of the tract *(kalpa)* is preserved. That subject is represented in verse 9 as having been communicated by the sage *(muni)* King of Kāśī *(Kāśī-rāja)* to Suśruta. By the sage, in all probability, Divodāsa is intended, also known as the divine surgeon Dhanvantari; and Suśruta undoubtedly refers to the celebrated author of what is now known as the *Suśruta-saṃhitā*. But it may be noted that in the concluding verse 43, the author, whoever he was, refers to himself in the first person *(ukto mayā)*.

The tract, or *kalpa*, on garlic is followed by another tract which might be described as a short *tantra*, or text book, comprising a number of very miscellaneous sections, arranged in a rather unmethodical fashion. It commences with remarks on the importance of regulating digestion (vv. 44-51), and with some pharmaceutic directions (vv. 55-59), such as are usually found in the so-called *sūtra-sthāna*, or section on the principles of medicine, of a *saṃhitā*. Interspersed are some alternative and aphrodisiac formulæ (vv. 52-54, 60, 61-67), such as are usually given in the *saṃhitā* sections on *rasāyana* and *vājīkaraṇa*. Next comes a section with formulæ for various eye-lotions (*āścyotana*, vv. 68-86). This is followed by another on face plasters *(mukha-lepa, vadana-pralepa,* vv. 87-105) and collyria *(añjana, viḍālaka)* and remedies for the hair, etc. (vv. 106-120); and finally there is a section on cough-mixtures (vv. 121-124). This second tract differs from the preceding in two respects. First, it employs only three metres, the *śloka* (44 verses), *triṣṭubh* (30 verses) and *āryā* (6 verses); and secondly, it uses the double stroke to mark, not the end of a verse, but the end of a formula (consisting of one or more verses) or of a section. In both respects it resembles the treatise of Part II.

(2) Part II contains a practical formulary, or handbook of prescriptions, cevering the whole field of internal medicine. It is called the *Nāvanītaka* or "Cream," and professes to give, for the use of the practitioner, a selection of the best prescriptions found in the standard medical works of the time; and though

these standard works are not actually named, it is possible in many cases to identify them. But in addition to these, it gives some formulæ which seem to be taken from the floating medical tradition, as well as a very few which appear to have been added by the author himself.

The formulary was originally divided into sixteen chapters. This, at least, was the intention of its author, as may be seen from his introduction (vv. 8 and 9), which enumerates the headings of the sixteen chapters. There is no good reason to doubt that the intention was accomplished; but whether or not the formulary was ever actually completed, it is now impossible to say, seeing that the solitary existing copy of it in the *Bower Manuscript* is incomplete, as the fifteenth and sixteenth chapters, as well as apparently the conclusion of fourteenth are missing.

The division of the chapters, and the distribution of the formulæ over them, are not made on any unitary principle. Some formulæ are put together on the principle of the form which is given to the medicament; others, on the principle of the purpose which the medicament is to subserve; others, again, on the principle of the kind of patients to whom the medicine is to be administered; and finally, some chapters are added describing some important "simples," vegetable or mineral. Thus, under the first principle we have the initial three chapters, which eunmerate formulae for preparing compound powders *(cūrṇa)*, medicated *ghee*-s or clarified butters *(ghṛta)*, and medicated oils *(taila)* respectively. The second principle is applied from two different aspects, according as the purpose of a medicament is, either to relieve or cure an abnormal condition of the system, or to stimulate or improve its normal functions.

Under the former aspect a large number of formulae are collected in the fourth chapter, referring to some twenty-two or twenty-four, not always clearly distinguished, diseases, the details of which may be seen in the Table of Contents, prefixed to this edition [i.e. Hoernle's edition of Bower MS in ASI —*Ed*]. The principle, however, is not quite strictly observed in the chapter; for right into the middle of it, two formulae are pitchforked, which belong to the preceding principle (the form

of a medicament), *viz.*, one (vv. 484-490) referring to the preparation of a linctus *(leha)*, the other (vv. 491-493), to the preparation of a kind of medicated mead *(madhvāsava)*. The reason why they are inserted here apparently is that their purpose is purgative and alterative respectively; but even in that case, their proper place would be under the second aspect of the therapeutic principle. In this connection it may also be noted that none of the formulae in Chapter IV may be understood as a "specific." In most cases the formula is stated to cure a number of, sometimes, very different diseases ; but one of these was thought to be its principal object, and this particular disease was, as a rule, indicated by being named at the head of the number. Under the second aspect of the therapeutic principle, formulae are distributed over the six Chapters V-X, treating of enemas (*vasti-karma*), alteratives *(rasāyana)*, gruels *(yavāgū)*, aphrodisiacs *(vṛṣya)*, collyria *(netrāñjana)*, and hair dyes *(keśa-rañjana)* respectively. Under the third principle, referring to the kind of patient, we have the three concluding chapters of the treatise, of which, however, only the fourteenth chapter on the diseases of children survives, while chapters XV and XVI, dealing with barren and child-bearing women, respectively, are missing. Intermediately there come in the three chapters XI-XIII, containing small monographs on chebulic myrobalan, plumbago-root, and bitumen respectively.

(3) Part III is another specimen of an ancient formulary, or manual of prescriptions. It is probably, however, a mere fragment of what was, or was intended to be, a larger work. The existing fragment corresponds to the initial portion, that is, to Chapters I-III, of the formulary in Part II; for it contains formulae put together on the principle of the form of the medicament. But though put together on that principle, the formulae are not arranged in any consistent order; powders, *ghee*-s, oils, pills, tinctures and liniments are mixed up, as shown in the subjoined list :

(1) Oils, formulae Nos. I, II, III, VII. (2) Powder, formulae No. IV. (3) Liniments formulae Nos. V, VIII, IX, XIII.

(4) *Ghee*, formula No. VI. (5) Pills, formula Nos. X, XII, XIV (6) Linctus, formula No. XI.

(4) Parts IV and V contain two short manuals of *Pāśaka-kevalī*, or cubomancy, that is, the art of foretelling a person's fortune by means of the cast of dies *(pāśaka*, or as spelled in Pt. IV, 1. 2. p. 192, *prāsaka)*. The mode of exercising this art can be best seen from the manual in Part IV, which is practically complete, while the manual in Part V is apparently very fragmentary. The former manual shows that the die which was used was marked with the four numbers 1,2,3,4; and that each cast, or rather (as we shall see) set of casts, cosisted of three of these numbers. Accordingly there could be no more than sixty-four possible casts.

All but four of these sixty-four variations occur in Part IV. The four which are missing [121, 211, 234, 124, ASI-edn.] have clearly been omitted through some inadvertence on the part of the scribe ; *viz.*, 234 on the reverse of the second folio, 124 on the obverse of the third folio, and 121 & 211 at the very end of the manuscript, on the reverse of the fifth folio. In Part V less than one-third [20 out of 64, shown in ASI-edn.], occur. No fewer than forty-four variations are missing; *viz*, the whole of the first class of groups (444, 333, 222, 111) ; one-half of the second class, namely, the whole groups *viṭī*, *kāṇa*, *sajā*, *pāñcī*, *cuñcuna*, and *kharī* ; and nearly the whole of the third class, only two variations (243 and 412) being preserved. What the cause of this multilation, whether intentional or other, may have been is not apparent.

At the end of the *Pāśaka-kevalī* manuscripts, No. 70 of the Deccan College, there is an appendix written in the modern Gujarātī vernacular language, which explains the *modus operandi* in this kind of cubomancy : "The mode of throwing the divination die *(pāśo*, singular) is as follows. When the die is wanted for an oracle (Skr. *śakuna*), it must be thrown three times ; and the first cast must be counted as hundred. Thus if one pip *(pagaḍam*, sing.) falls, it counts 100 ; if two pips *(pagaḍāṃ*, plur.) fall, they count 200 ; if three pips fall in the first cast, they represent 300 ; if four pips fall, they count 400. Next, the die

(pāso, sing.) is thrown for the second time. Then, of the pips that fall, one counts as the figure *(āṃk)* 1 ; similarly if two pips fall, they are 2 ; if three fall, 3 ; if four fall, 4. In the same way, the cast of the third time must be understood. Finally, the hundred of the first throw, and the figures *(āṃk)* of the second and third, must be placed together. Whatever (combined) figure results, upon that the oracle must be pronounced. Thus if first one falls, next two fall, next, at the third throw, three fall, then it is the (combined) figure 123, one hundred and twenty-three. Similarly, if at the first (cast) two fall, next one falls, next three fall, the result is the figure 213, two hundred and thirteen. This is the correct manner of proceeding."

It is clear from this explanation that in the ancient Indian art of cubomancy only a single die was used; and that the die indicated only the four numbers, respectively represented by 1, 2, 3, 4 pips on four different facets. A die in the form of a tetrahedron would satisfy these conditions; but the existence of a tetrahedral die at any time is, I believe, an unheard-of thing. It seems probable, therefore, that the die was one of that elongated kind, with four long sides and two rounded ends, which is known as *talus* or *astragalus*, or knucklebone, and on which the four long sides were marked with pips. If the die had the ordinary cubical form, two of its six equal sides would have borne no pips ; and then there would have been the not infrequent chance of one of the two unmarked facets turning up in any of the three consecutive casts. In such a case, of course, the throws would have had to be repeated, till some tip-marked facet turned up; but the explanation above-quoted does not seem to contemplate the occurrence of such an eventuality, which is not even alluded to. At the same time there occurs in the Introduction to the manual in Part IV (1.3), an obscure phrase which may point to the die having had the form of a six-sided cube. There the dice are described as *kumbhakārī-mātaṅga-yyktā,* lit., "joined with a *kumbhakārī* and a *mātaṅga.*" This may mean marked with the figures of a *kumbhakārī,* or potter woman (or the girl *kumbhakārī*), and *mātaṅga,*

or elephant (or Caṇḍāla man). These two figures might have stood on the two sides not marked with pips. Another explanation of the phrase, however, is possible which is given in note 1 on page 197. There is also another difficulty in the circumstance that the introduction (ll. 2. 3) speaks of dice in the plural number, *prāsakā[ḥ] patantu*, "may the dice fall." But the reference may very well be, not to the number of several dice, but the number of casts of a single die. If more than one die should really have been used, the number of the dice, of course, would have been three ; and each act of divination would have required but a single cast, the three dice being thrown at one time. They would probably have been loose ; though at the present day the dice of the Indian cubomancer, which moreover are four in number, are strung on a short thin iron rod. A description of this kind of modern cubomancy is given on pp. 44-46 of Peterson's *Third Report on the Search of Sanskrit MSS.* in the *Journal* of the Bombay Branch of Royal Asiatic Society, Extra No. for 1887, in connection with a work called *Ramālāmṛta*, or "the fine art of Ramal." The Arabic term *ramal* signifies geomancy, or any kind of divination, specially cubomancy. The performer always, or often, is a Muhammedan. In the above-mentioned case, reported from Bombay, the four dice seem to have been immovably fixed on the rod; but in a case examined by me in Calcutta, they were loosely strung on the rod round which they could rotate freely, though they were secured from falling off the rod by two rod-heads. This mode of cubomancy, however, seems to be a comparatively modern importation into India, and is, therefore, hardly relevant to the understanding of the mode of cubomancy which forms the subject of the two manuals.

These two manuals are quite independent works. Their oracles, though of course touching on similar subjects, are totally different compositions, of much greater length in Part V than in Part IV. In early Indian times several cubomantic manuals appear to have been current. The manuals, which

survive at the present day and are ascribed to the authorship of the sage Garga, possess a few striking points of agreement with the manual in Part V. The subject of these agreements is fully discussed in the appendix to Part V, pp. 214 ff. The evidence points to the existence of three rather widely different recensions of what may possibly have been originally a single manual. The latter might possibly be represented by the recension preserved in the *Bower Manuscript.* This recension is of considerable antiquity. As shown elsewhere it may have existed as early as the second century A.D., and of course it may go back to a much earlier time. The other existing recensions cannot be older than the end of the fourth century, because in the fifth verse of their introduction they speak of cubomancers as possessing *horā-jñāna,* or the knowledge of the doctrine of *horā* (Greek *or*), or lunar mansions (Latin *domus).* The first mention of that doctrine has been traced by Professor Jacobi (in his dissertation *de astrologiae indicae horā appellatæ originibus,* Bonn 1872) to Firmicus Maternus, who lived about 335-350 A.D. in the West, whence it came to the knowledge of the Indians. For some further information on the subject of Indian cubomancy the student may be referred to A. Weber's paper in the *Monatsberichte der Kgl. Preussischen Akademie der Wissenschaften,* Berlin, 1859, pp. 158 ff., and in the *Indische Streifen,* vol. I, pp. 274 ff. ; also to Dr. J. E. Schroter's Inaugural Dissertation on *Pāśaka-kevalī, ein indisches Würfel-orakel* (Borna, 1900). The latter contains a critical edition of the recension of the manual on cubomancy, ascribed to Garga.

(5) Parts VI and VII contain two different portions of the same text, which is a *sūtra* or *dhāraṇī* referring to a charm protective against snakebite and other evils. The name of the Sūtra is *Mahāmāyūrī Vidyārājñī* (sel. *Dhāraṇī),* lit., the 'great peacock' queen of charms. It apparently takes its name from the fact that the peafowl *(mayūra)* is the great traditional enemy of the snake. It is a charm of great repute among the Buddhists, and is included in the highly valued collection of *Dhāraṇī*-s, called *Pañca-rakṣā,* or the Five Protective Charms. In this collection it usually takes the third place (see *Catalogue* of

Buddhist Sanskrit MSS. in Cambridge. No. 1325, p. 48, etc; *Catalogue* of Sanskrit MSS, Part II, in Oxford, No. 1447, p. 257, and *Catalogue* of Buddhist Sanskrit Literature in Calcutta, No. B4, pp. 164-8 and p. 173); but sometimes the second (see the Oxford *Catalogue*, No. 1448, p. 259, and apparently the Cambridge Catalogue, No. 1662, p. 162), or the fourth (see Catalogue of Buddhist Sanskrit MSS. of the Royal Asiatic Society, No. 56, p. 42). The *Pañca-rakṣā* itself is sometimes found included in certain larger *Dhāraṇī-mantra-saṃgraha*, or Collections of Dhāraṇī charms (see the Oxford Catalogue, No. 1449, p. 260, and the Calcutta Catalogue, No. B5, pp. 80, 292).

In the *Pañca-rakṣā* collection, however, the *Mahāmāyūrī* charm exists in a greatly expanded form. This expanded recension, as may be seen from the Chinese translations of the charm, appears to have developed in the course of the fifth or sixth centuries A.D. There are six such translations enumerated in Nanjio's *Catalogue* of the Chinese Tripiṭaka, Nos. 306-311. Three of them are based on the expanded recension of the Sūtra, while the three others exhibit the Sūtra in a more primitive and much less developed form. To the former belong two translations of the eighth century A.D. (Nos. 306 and 307),done by It-sing in 705 A.D., and Amoghavajra in 746-771 A.D. respectively; and a somewhat shorter translation of the sixth century (No. 308), made by Saṅghapāla in 516 A.D. The three more primitive recensions (Nos. 309, 310, 318) belong all to the fourth century A.D., *viz.* two by Poh Śrīmitra under the Eastern Tsin dynasty, 317-420 A.D. and one by Kumārajīva under the later Tshin dynasty, 384-417 A.D. At the time these six translations were made, the *Mahāmāyūrī-sūtra* seems to have still existed as a separate work, and not yet to have formed a component part of the *Pañca-rakṣā* collection. That collection would seem to have originated in Bengal under the Buddhistic Pāla dynasty, not earlier than the tenth or eleventh centuries A.D. For another of the later component parts of the *Pañca-rakṣā*, namely, the *Mahā-sahasra-pramardinī-sūtra*, was translated into Chinese (Nanjio's No. 784), when it was still a separate

work, by Sh'hu (Dānapāla ?) about 980-1000 A.D., while the *Pañca-rakṣā* collection itself, being a late production, does not seem to have been translated into Chinese at all.

The relative extent of the two recensions of the *Mahāmāyūrī-sūtra,* in the *Pañca-rakṣā* collection and the *Bower Manuscript,* may be seen from the Appendix to Parts VI and VII [Hoernle's edition of Bower MS in A.S.I. pp. 240*a* ff.]. These two Parts include only an extremely small portion (about one-seventh) of the modern expanded version of the Sūtra, *viz.* its second and third section. The former relates the story of the monk Svāti and his recovery from the fatal bite of a snake through the application of the Mahāmāyūrī charm; the latter, the story of the obtainment of that charm by Buddha in one of his former births *(jātaka)* as the king of the peacocks *(mayūra-rāja)*. These two stories would seem to have made up the whole extent of the original Sūtra before its subsequent enormous accretions. From the *Bower Manuscript* it appears that the copy of the Sūtra included in it was written for the benefit of the person (probably a monk or abbot), called Yaśomitra, whose name, as usual in such cases, was inserted at the end of the copy. This copy, being written on birch-bark of an inferior quality, after a time became seriously damaged : the obverse of the folio, on which the second story commenced, flaked off entirely, and that portion of the manuscript which contained the first story appears to have been destroyed altogether. The latter was now replaced by a fresh copy, written on a new supply of birch-bark of a superior quality. This fresh copy is the existing Part VI of the *Bower Manuscript.*

THE COMPOSITION OF THE CARAKA-SAṂHITĀ IN THE LIGHT OF THE BOWER MANUSCRIPT

An essay in historical and textual criticism[1]

A. F. R. HOERNLE

In a previous contribution (*JRAS*, iv, 1908, pp. 997 ff.), discussing Dṛḍhabala's share in the composition of the *Caraka-saṃhitā*, I had indicated what appeared to be conclusive evidence of the truth of one of the two traditional serial orders of the chapters of its *Cikitsita-sthāna*, and it is adopted by Gaṅgādhara in his well-known Berhampur edition of the *Saṃhitā*.

In the present contribution I propose to explain what evidence there is on the other side. In the main it is the evidence extractible from the large medical treatise called *Nāvanītaka*, which forms the second part of the *Bower MS.* As the date of that MS. falls somewhere in the second half of the fourth century A.D.,[2] and as the *Nāvanītaka* quotes numerous formulae from the *Cikitsita-sthāna* of Caraka's *Compendium*, it seems obvious that none of the chapters of the latter, from which quotations occur in the *Nāvanītaka*, can have been written by Dṛḍhabala, who lived several centuries later, probably in the ninth century A.D.[3]

1. In addition to the texts mentioned in n. 2 on p. 997, *JRAS*, 1908, the following are quoted in this paper : BS. equal to *Bheḍa Saṃhitā ;* D. NS equal to Ḍallana, *Nibandha Saṃgraha*, ed. Jīvānanda, 1891 ; Nāv. equal to *Nāvanītaka*, Part II of the *Bower MS ;* V. CS equal to Vaṅgasena, *Cikitsāsāra Saṃgraha*, ed. Nanda Kumāra Gosvāmī, Calcutta, Śaka 1811. Also *Rec. Dec.* equal to Dr. P. Cordier, *Recentes Decourvertes de MSS. medicaux Sanscrits dans l'Inde*, 1903 ; *Orig.* equal to Dr. P. Cordier, *Origenes, Evolution et Decadence de la Medicine Indienne.*
2. On the date of the *Bower MS, Ind. Ant.*, 1892, vol. xxi, pp. 29 ff. In that dissertation the date had been fixed in the middle of the fifth century. A re-examination of the whole case, in the light of more recent information, has shown that the date must be placed about a century earlier. The details will be found in the Introduction to my edition of the *Bower MS*, which is now in preparation.
3. On his date, see my *Osteology of the Ancient Indians* § 10 ff., pp. 11 ff.

The date of the composition of the *Nāvanītaka* is probably much earlier than that of the writing of the *Bower MS.*, in which it has been preserved for us. That the latter is not the autograph of the author of the *Nāvanītaka*, but is a copy of a pre-existing work, is proved by various marks in the MS. Thus in the forty-fifth verse of the fourteenth chapter (p. 28 of my edition) we find the reading *...vya-phalāni*, where the omission of three *akṣara* is indicated by three dots (see Plate VII, facsimile of leaf 2, Reverse, line 4). At the time of editing the text I suggested the emendation *trīṇi cavya-palāni*. In the meantime the formula to which the forty-fifth verse belongs has been identified by Dr. Cordier[4] in the *Bheḍa-saṃhitā*, from which it is seen that the true reading is *pañca cavya-palāni*. Obviously the lacuna is due to the fact that the writer of the *Bower MS.*, finding himself unable to read (if illegible) or to supply (if missing) the three *akṣara* in his original, replaced them by three dots, a procedure simply unthinkable if the writer had been also the author of what he wrote. The misspelling of *phalāni* for *palāni*, of course, might be a mere *lapsus pennae* on the part of the author, seeing that the characters for *pha* or *pa* differ only by a slight curl or hook. Still, even this error points more readily to a copyist from an illegible or defective original. There are numerous blunders in the *Bower MS.* of a similarly suggestive character. In verse 723 of the Pippalī-vardhamāna formula (ed., p. 58), we have the curiously blundered phrase *yāvad=daśa-varṣas*, instead of *yāvad=avakarṣas*. The former cannot be explained as a mere *lapsus pennae*, and as it is quite nonsensical in the context, it cannot possibly be ascribed to an author, but must be due to a thoughtless copyist of a badly legible original. Again, to verse 879 (ed., p. 67) there is appended the gloss *prācīnikā pāṭhā*, in order to explain the unusual name, *prācīnikā*, of the drug commonly known as *pāṭhā*.[5] As

4. See his *Rec. Dec.*, p. 21. I have since verified the identification from my own copy of the *Bheḍa Saṃhitā*. It is curious that the MS. of the latter exhibits the same error *phalāni* for *palāni*.

5. The *Nighaṇṭu*-s (Dhanvantari, Madanapāla, Rāja) give only *prācīnā* as a synonym of *pāṭhā*.

usual, that gloss must have stood originally on the margin, or perhaps between the lines, of the manuscript copy which some one made for himself from the autograph. By some subsequent copyist it was transferred into the body of the MS., that is, into the position where we now find it in the *Bower MS.* The writer of the latter may, or may not, have been the first to make that transfer; in fact, it is easy to see that the case admits of a succession of copies between the autograph and the existing copy of the *Nāvanītaka*. In the sequel it will be shown that there are indications in the *Nāvanītaka* pointing to a rather considerable interval, perhaps two or three centuries, between its composition and the copy in the *Bower MS.* On that assumption the argument referring to Dṛḍhabala's share in the composition of the *Caraka-saṃhitā* gains considerably in force. But, after all, even if the composition and the copy were practically contemporaneous, the argument remains perfectly valid.

The author of the *Nāvanītaka*, in the first verse of his Introduction, explains that his treatise is intended to "contain the foremost formulae of the (medical) Maharṣis, made by them of old". He nowhere explicitly mentions the Maharṣis, or great medical authorities, from whom he takes his formulae. In this he follows the usual practice of medical compilators. Thus one of the largest compilations of this kind, the so-called *Vaṅgasena*,[6] or, with its proper name, *Cikitsā-sāra-saṃgraha*, hardly ever indicates its authority, and then only indirectly. Yet it contains very copious extracts from Mādhava's works without any indication whatsoever.[7] And the great Mādhava himself has constituted the larger part of his *Nidāna* by means of extracts from the Compendia of Caraka and Suśruta, without specifying his sources. This practice indeed is universal among the ancient Indian writers, and however we may regret it from our modern

6. Vaṅgasena is really the name of the author, probably in the twelfth century A.D. In the Calcutta edition of Nanda Kumāra Gosvāmī (1889) the work runs into 1127 pages.

7. See also *India Office Catalogue*, p. 951, and Professor Jolly's *Indian Medicine*, p. 6.

text-critical point of view, we should be wrong to condemn it as plagiarism. Those writers had no thought of deceiving anyone or representing as their own what they took from others. They always warn their readers by some introductory general announcement that they are going to draw on what were considered standard works in their time. Thus Mādhava in the second verse of the Introduction to his *Nidāna*, states that the work is "compiled from the sayings of several sages".[8] Similarly the author of the *Nāvanītaka* opens his work with the statement that it is "compiled from the leading formulae of the great sages of old".[9] But what an advantage it would have been to us at the present day if he had descended to particulars and specified the author of every formula which he has incorporated in his compilation.

However, as a matter of fact, the author of the *Nāvanītaka*, in one way or another, in a considerable number of cases, does indicate his sources. For example, in verses 917-49 (ed., pp. 68-70) he gives a *kalpa*, or pharmacological monograph, on *harītakī*, or *chebulic myrobalan*. These verses are introduced by him with the remark : "Now I will relate the *harītakī-kalpa*," and appended to them is the remark : "(This is) the *harītakī-kalpa* of the Aśvins." This procedure evidently suggests that the *kalpa* is a treatise, or perhaps an extract from a treatise, ascribed to the Aśvins. There still survive fragments of an *Aśvinī-saṃhitā*, or Compendium of the Aśvins, of which Dr. P. Cordier possesses copies *(Rec. Dec.*, p. 29). They contain two versions of a *harītakī-kalpa*, which Dr. Cordier has kindly communicated to me, and which are printed on pp. 180*b-f* of my (revised) edition. They differ, however, so widely from the version contained in the *Nāvanītaka* that it is impossible to con-

8. MN., *nānā-munīnāṃ vacanair-nibadhyate ;* and Nāv., *prākpraṇītair-maharṣīṇāṃ yoga-mukhyaiḥ samanvitam.*
9. See e.g. SS. vi, 18, v. 1, 66, v. 1, where Suśruta is called *Vaiśvāmitra* and *Viśvāmitra-suta* respectively. In the *Lalitavistara*, ch. x, p. 142, Viśvāmitra is said to have been the teacher of the boy Buddha. See also *Mahābhārata*, Anuśāsana, iv, 55. A formula of his is quoted in the Commentary to M.S., ch. xxx, vv. 40-43 (p. 269), which in another version, is found in SS., vi, 42, vv. 24-5 (p. 805). See also *Orig.*, p. 84.

sider the still surviving *Aśvinī-saṃhitā* as its source. Rather the latter gives the impression of being a comparatively late compilation, which, however, very possibly is elaborated from the same source as that from which the *Nāvanītaka* quotes. Besides the *harītakī-kalpa,* the *Nāvanītaka* contains a number of medical recipes, the authorship of which it also ascribes to the Aśvins. The following is a complete list of all such passages :

(1) Aśvinī Mātuluṅga-guḍikā, or citron-pills of the Aśvins, vv. 75b-7a (ed., p. 30), against *śūla,* or colic pains.

(2) Another kind of Aśvinī Mātuluṅga-guḍikā, vv. 80-4 (ed., p. 30), against *kāśa,* or cough.

(3) Āśvina Gulma-cūrṇa, or abdominal tumour powder of the Aśvins, vv. 85-6 (ed., pp. 30-1).

(4) Āśvina Haridrā-cūrṇa, or turmeric powder of the Aśvins, vv. 96-101 (ed., p. 31), against *ajīrṇa,* or indigestion.

(5) Āśvina Laśuna-ghṛta, or garlic ghee of the Aśvins, vv. 216-22 (ed., p. 37), against *vāta-vyādhi,* or rheumatic diseases.

(6) Āśvina Jvara-hara-ghṛta, or antifebrile ghee of the Aśvins, vv. 223-5 (ed., pp. 37-8).

(7) Āśvina Viṣa-ghṛta, or antitoxic ghee of the Aśvins, vv. 241-44 (ed., pp. 38-9).

(8) Āśvina Bindu-ghṛta, or drop-meal ghee of the Aśvins, vv. 251-7 (ed., p. 39).

(9) Amṛta-taila, or ambrosial oil, vv. 287-312a (ed., p. 41).

(10) Āśvina Raktapitta-yoga, or haemorrhage formula of the Aśvins, vv. 418-25 (ed., p. 47).

(11) A Kṣīra-yoga, or medicated milk formula, v. 575 (ed., p. 54), against strangury.

(12) An Ayorajīya-yoga, or iron-dust formula, v. 579 (ed., p. 54), also against strangury.

(13) Aśvinor-Aśvagandhā-vasti, or the *Withania somnifera* enema of the Aśvins, vv. 618-25a (ed., pp. 56-7), a tonic recipe.

(14) Pippalī-vardhamāna-rasāyana, or graduated pepper tonic, vv. 716-37a (ed., pp.58-9).

(15) Āśvina-rasāyana, or tonic of the Aśvins, vv. 773b-81a (ed., p. 61).

(16) Aśvinīya-yavāgūtraya, or the Aśvins' formula for three gruels, vv. 810-13 (ed., p. 63), against disorders of the three humours respectively.

(17) Āśvina-harītakī-kalpa, previously mentioned.

As yet, so I understand, none of these formulae, except the seventeenth, have been traced by Dr. Cordier in his fragments of the *Āśvina-saṃhitā*. But thirteen from among them (Nos. 1-8, 10, 13, 15-17) are specially indicated by their names in the colophons as belonging to some Āśvina source, which we may provisionally take to have been the same as that from which the *Harītakī-kalpa* was taken. The remaining four formulae (Nos. 9, 11, 12, 14) are expressly attributed to the Aśvin pair by a remark embodied in the formula itself. A similar remark, confirming the attribution in the colophon, is embodied also in the text of the five formulae, Nos. 5, 8, 10, 15, 16.

With regard to the authorship of these remarks, that in the *rasāyana* formula (No. 15) is particularly instructive. The last verse of that formula (v. 781 a) implies that by the medical tradition the formula was ascribed to the ancient physician Viśvāmitra, apparently the reputed father of Suśruta[10]. The ascription is contradicted, however, by the initial verses (vv. 773b and 774)[11] and by the colophon, both of which attribute the formula to the Aśvin pair. This discrepancy seems best accounted for by the assumption that the initial verse, which has no essential connexion with the recipe, no less than the

10. Verse 781a, *Viśvāmitrena cābhāṣṭam ṛṣibhiś cābhipūtjiam*, i.e. (this formula) was declared by Viśvāmitra and highly esteemed by the Ṛṣis. But verse 773b, *tapyamānaṃ tapo'tyugraṃ Viśvāmitraṃ mahāmunim / Aśvinau deva-bhiṣajāu—ucatur varadāṃ varau*, i.e., to Viśvāmitra, the great sage, engaged in a most severe ascetic exercise, the Aśvin pair, the divine physicians, the best of benefactors, declared (this formula).

11. Unfortunately, in the old Cambridge MS., Add. 1707, of 1275 A.D., *Ind. Off. Cat.*, p. 952, which I have examined, that portion which should have contained the formula is missing. The MS., fol. 100, ends on p. 172 of the print, and only recommences on fol. 503 with p. 990 of the print.

colophon, is due to the author of the *Nāvanītaka*. He would seem to have had reason to believe that the formula was really devised by the Aśvins. Accordingly he so named it in the colophon, and prefixed the initial verse in order to explain that it was really the Aśvins who communicated the formula to Viśvāmitra. The same conclusion is suggested by the *raktapitta* formula (No. 10). Here the formula proper, that is, the actual medical prescription, begins with verse 419b, and is preceded, in verses 418 and 419a, by a lengthy explanation that that prescription was taught to Indra by the Aśvin pair, though the attribution to the Aśvins is actually embodied in a brief remark in the final verse 425. In the compilation of Vaṅgasena, however, where the formula, with its final attribution, is also quoted (V. CS, ch. viii, vv. 93-9a, pp.226-7, Ind. Off. No. 1433, fl. 97b, 1.7), the lengthy introductory verses are omitted.[12]

And that this omission is not due to any accidental cause is shown by the fact that in the colophon the formula is called *candanādya-ghṛta*, or ghee medicated with sandal and other drugs. For as the formula proper (the medical prescription) begins (in v. 419b) with *candana*, sandal, and as it is the usual practice with Indian pharmacists to name a formula by its initial drug,[13] it is apparent that the introductory verses (vv. 418-19a) are not an essential part of the formula, and were not known to the general medical tradition from which Vaṅgasena gathered the formula for his compilation, but that their addition is due to the author of the *Nāvanītaka* himself, and (in view of the final verse) are really a piece of supererogation.

Similarly the attributory remarks in the other formulae may be due to the author of the *Nāvanītaka*. Both formulae, Nos. 11 & 12, are quoted by Mādhava in M.S., ch. xxxii, vv. 13 and 21 (pp. 279-80), and thence by Vaṅgasena in V. CS., xxxiii, vv. 29, 48 (pp. 497, 499), but without the attributory remark of the *Nāvanītaka*.

The formula No. 8 consists of five verses. In another ver-

12. See the rule in the *Paribhāṣā-pradīpa*, quoted in Gupta's *Medical Dictionary* under *yoga*.

13. Both at present inaccessible to me for verification.

sion, identical in substance, but compressed into two verses, the formula is found in V. CS., ch. xxx, vv. 106-7 (p. 482). In the same or a similar short version, as Dr. Cordier informs me (privately, October 25, 1904; see also *Rec. Dec.*, p. 21), the formula is ascribed to Kṛṣṇātreya by Niścalakara in his *Ratnaprabhā*, and by Candraṭa in his *Yoga-ratna-samuccaya.*[14] From this it is clear that the formula occurred in different versions, in different treatises, by different authors, and that the author of the *Nāvanītaka*, for some reason, preferred the longer version.

We have an exactly similar case in No. 14. This is a long formula of 22 & half verses describing a curiously complicated treatment, with daily increasing, and subsequently decreasing, doses of aments of long pepper *(pippali,* Piper longus). After a preliminary purging dose of medicated oil or ghee, the patient is to eat one ament on the first day, and then for ninety-nine consecutive days the dose is to be increased by one pepper every day, so that on the hundredth day the patient will eat one hundred aments at one dose. Henceforth the dose is to be gradually reduced by one pepper daily, till it is finally omitted. After every dose milk is to be taken, and at the end of the whole course a milk diet is to be observed for one week, for another week a diet of pulses and rice, and for a third week a diet of broth of game and juice of certain plants. The whole course of treatment thus occupies a period of 100+99+21, or 220 days. It also involves the consumption within that period of not less than 10,000 aments of long pepper. By the side of this complicated formula there exists another greatly simplified one, which reduces the length of the period and the total number of peppers. It permits several options : while in every case the period is twenty days, the ratio of the peppers may be 10, or 6, or 5, or 3, and consequently the total of peppers con-

14. In SS., iv, 5, cl. 14, p. 406, the name *pippalī-vardhamāna* is incorporated in the text of the formula. In CS., vi, I, v. 140, p. 424, it is only in the colophon, and even there only in some MSS., e.g. Tüb. 459 and Decc. 925. In other MSS., as in Tüb. 458, I.O. 335, there are no colophons to any of the formulae.

sumed is 1000, or 600, or 500, or 300. It seems reasonable to conclude that it was the inconvenience of the original formula, both with respect to the length of time and the enormous total of consumed peppers, which led to the simplification; and, as a matter of fact, even the simplified formula, survives at the present day only in its mildest form, which prescribes the ratio of three peppers a day (U.C. Dutt's *Materia Medica*, p. 243; *Pharmacographia Indica*, vol. iii. p. 177). The option with the ratio of ten, however, may serve as an illustration of the simplified formula. The patient is to take ten aments on the first day, increasing the dose by ten on each of nine succeeding days, so that on the tenth day he takes one hundred peppers. Thenceforward he reduces the dose by ten on each succeeding day, till finally the dose is omitted on the twentieth day. This course works out 550 in the crescent, and 450 in the decrescent part or a total of 1000 peppers. It is for this reason that the simplified formula is sometimes found distinguished as the *pippalī-sahasra*, or thousand-pepper formula, from the longer *pippalī-vardhamāna*, with its total of 10,000 peppers. Both forms are quoted in the *Nāvanītaka*, the longer in verses 716-37 a (No. 14 in the list), the shorter in verses 749-52. While the former, as we have seen, is expressly ascribed to the Aśvin pair, the author of the simplified formula is not mentioned. We know him, however, from the fact that it occurs in Caraka's Compendium (CS, vi, 1, vv. 136-40). As that compendium is based on the *Tantra* of Agniveśa, and as that *Tantra* embodies the teachings of Ātreya, it follows that the simplified formula goes back to Ātreya's. It also follows that the longer formula, on which Ātreya's simplification was modelled, and which certainly impresses one as more archaic, goes back to the mythic or semimythic time antecedent to Ātreya. That explains its attribution (in the final verse 736 b)to the mythic Aśvin pair, as well as its gradual obsolescence. It is ignored already in Suśruta's Compendium, the *pippalī-vardhamāna* of which (SS, iv, 5, cl. 14, p. 406; see also p. 770, v. 194) is practically identical with the shorter version of Ātreya-Caraka. In fact, so far as I know, the longer version has not survived in any medical

work, except the *Nāvanītaka*. The single indication of its former existence that I can recall occurs in a formula in Vāgbhaṭa II's *Aṣṭāṅga-hṛdaya* (iv, 15, vv. 39-41), which, in the case of abdominal complaints *(udara)*, recommends, in addition to other remedies, either the *pippalī-vardhamāna* or else the *pippalī-sahasra*. It is evident that the author of that formula knew both, the longer as well as the shorter treatment with pepper. One could wish that Vāgbhaṭa II had mentioned the source whence he obtained his knowledge of the formula. It does not appear to have been the *Aṣṭāṅga-saṃgraha* of Vāghaṭa I (in the early seventh century), which as a rule serves as his source. For that work, if one may trust the Bombay edition (vol. ii, p. 97, l. 8), mentions only the *pippalī-vardhamāna*, by which name at that time (i.e. the time of both Ātreya-Caraka and Suśruta)[15] the shorter version was understood. It is interesting to observe that the commentator Aruṇadatta (about 1220 A D.) appears to have no longer understood what the two versions were; for, commenting on the optional treatment recommended in his text, he explains that the *pippalī-vardhamāna* should be taken as directed in the chapter on *rasāyana*; but the *pippalī-sahasra* he does not explain. On referring to the chapter on *rasāyana*, we find that the only *pippalī* formula there given (AH., vi, 39, vv. 98 b-100 a) is the shorter version of Ātreya-Caraka, and commenting on this Aruṇadatta says that it is the *pippalī-sahasra*. So that he practically identifies the two versions despite their clear differentiation in the formula of the *Aṣṭāṅga-hṛdaya* (iv, 15, 39-41); evidently he was at a loss what to make of that differentiation.

15. All these passages were first recognised by Dr. P. Cordier. He published a list of most of them in his *Rec. Dec.*, p. 21, and communicated all of them to me privately in October, 1904. Since then I have verified them in my own copy of the Tanjore MS. of the *Bheḍa-saṃhitā* (on which see my *Osteology*, p. 38. n.1). The references to the folios in the list are to those of the original MS. in Tanjore. The *Bheḍa-saṃhitā* is divided into precisely the same eight *sthāna* as the *Caraka-saṃhitā*. Accordingly the Roman numerals i, vi, viii in the list refer to the Sūtra, Cikitsita, and Siddhi Sthāna respectively. The chapters *(adhyāya)* indicated by Arabic numerals differ in the two Saṃhitā. Accordingly in the list the subject of the chapter is named.

It was necessary to go rather fully into the case of No. 14 of our list because it throws considerable light on what appears to be the method of the author of the *Nāvanītaka* in dealing with his materials. It seems to be this : when he quotes a formula (such as the *pippalī-sahasra*) from a standard compilation (such as the *Caraka-saṃhitā*) he does not consider it necessary to specify his source; but when he quotes a formula (such as the *pippalī-vardhamāna)* from what may be said to have been the floating medical tradition of his time he identifies the reputed author of the quoted formula by some remark, either added to it, or in a colophon appended to it.

Another standard compilation of his time, from which the author of the *Nāvanītaka,* according to the method just explained, quotes anonymously, is the *Bheḍa-saṃhitā*, or Bheḍa's Compendium. The following is a complete list of the quoted passages.[16]

(1) Ayorajīyacurṇa, or iron-dust powder, vv. 43-55 (ed., pp. 28-9); in BS., vi, 16 *(śvayathu)*, vv. 33-45b (fol. 138).

(2) Rāsāyanika-ghṛta, or tonic ghee, vv. 165b-9a (ed. p. 35); in BS., vi, 4 *(rājayakṣman)* (fol. 100b).

(3) Daśāṅga-ghṛta, or ten-ingredient oil, vv. 201-3 (ed., pp. 36-7); in BS., vi, 5 *(gulma)*, vv. 17b-20a (fol. 105a).

(4) Bāla-ghṛta, or *Sida cordifolia* ghee, vv. 280-6 (ed., pp. 40-1); in the *Yogaratna-samuccaya.*

(5) *Sahacara-ghṛta*, or *Barleria cristata* ghee, vv. 329-36 (ed., p. 43); in BS., vi, 24 *(vātavyādhi)*; mutilated (fol. 153b).

(6) Madhuyaṣṭikā-taila, or liquorice oil, vv. 337-43 (ed., p. 43); in BS., vi, 4 *(rājayakṣman)*; probably mutilated (fol. 103a).

(7) Gaṇḍamāla-yoga, or an adenia prescription, vv. 399-401a (ed., p. 46); in the *Yogaratna-samuccaya.*

(8-10) Three Āmātisāra-yoga, or diarrhoea prescriptions, vv. 407-12 (ed., pp. 46-7); in BS., vi, 10 *(atisāra)* (fol. 116a).

(11) Kāśa-yoga, or a cough prescription, vv. 474-9 (ed., p. 50); in BS., vi, 19 *(kāśa)*, vv. 26b-32 (fols. 143b-4a).

16. The copies of that MS., which are in the possession of Dr. Cordier and myself, do not, of course, constitute additional authorities.

(12) Karṇaśūla-yoga, or an ear-ache prescription, vv. 534b- a (ed., p. 53); in BS., vi, 22 *(karṇaroga)* (fols. 147b-8a).

(13) Tailādya-vasti, or an oily enema, vv. 642-4 (ed., p.58); in BS., viii, 9 *(uttara-vasti)* (fol. 201).

(14) Bheli-yavāgū, or the Bheḍa gruel, vv. 802-4 (ed., p.63); in BS., i, 7 *(indriyopakramaṇīya)* (fol. 10).

(15) Lakṣādi-sarpiḥ, or lac ghee (for children), vv. 1059-60a (ed., p. 74); in the *Yogaratna-samuccaya*.

Of these fifteen formula, all but three (Nos. 4, 7, 15) can be actually identified in the Tanjore MS. of the *Bheḍa-saṃhitā*, the single MS. of the work at present available.[17] Unfortunately the Tanjore MS. is not in a satisfactory condition. Not only are its readings in many places very corrupt, but it contains also extensive lacunae. Considering the condition of the MS. its close verbal agreement with the *Nāvanītaka* in the case of nine formulae (Nos. 1-3, 5, 6, 8-10, and 12) is surprising. Of No. 5 a large portion is wanting in the Tanjore MS., but what survives is identical with the *Nāvanītaka*. In the case of two formulae (Nos. 11 and 13) it is true there are considerable textual differences. But in addition to the two countervailing points before mentioned, it is to be remembered that the Tanjore MS. is of a comparatively modern date (c. 1650 A.D.), and has been subject to all the vicissitudes of literary transmission, especially formidable in the case of an unfamiliar work. As to the three exceptions (Nos. 4, 7 and 15), I am informed by Dr. Cordier (privately, October 25, 1904) that they are attributed to Bheḍa by Candraṭa in his *Yogaratna-samuccaya*. As that work is not accessible to me, I am not able to judge of the exact terms of the attribution. It may be that it does not necessarily imply that Candraṭa transferred the formulae to

17. Two similar examples are No. 7 *(ṣaṭpala-ghṛta)* and No. 16 *(prastha-vireka)*, which in the printed Caraka editions are named *pañcakola-ghṛta* and *dantī-harītakī*. Neither pair of names is found in any Caraka MS., and the latter pair seems to occur first in Cakrapāṇidatta. Another illustrative case is No. 15, which bears no name at all, in either the *Nāvanītaka* or the Caraka MSS. In the Caraka editions it is named *drakṣādya-ghṛta*, and this name again, seems to appear first in Cakrapāṇidatta (ch. xxx. no. 40, p. 349).

his compilation from the *Bheḍa-saṃhitā*. He might have found them in the floating medical tradition.

The case of No. 14 of our list is pecular and puzzling. This is a formula for the preparation of a gruel medicated with three different sets of substances according as one of the three humours (air, bile, phlegm) is disordered. To it is appended a form of charm (v. 803), which the patient is directed (v. 804) to repeat after having taken the gruel, in order to make the remedy effective. The charm and the direction how to use it (vv. 803-4) are found identically in the *Bheḍa-saṃhitā*, but there they are not connected with any formula for the preparation of any gruel, but occur at the end of the seventh chapter of the Sūtra Sthāna, which deals with *indriyopakramaṇīya*, that is, with general rules for the preservation of bodily and mental health. That the charm stands here in its proper place is shown by the fact that the corresponding chapter in the *Caraka-saṃhitā* (i. 8, cl. 31, p. 49) concludes with a very similar charm. There is no apparent reason why it should be connected with a particular formula for preparing a gruel and it seems probable that in the MS. of the *Nāvanītaka* it got displaced by some error of the scribe. On this hypothesis the colophon Bheli-yavāgū does not refer to the charm (in vv. 803-4), but only to the preceding formula (in v. 802) for the gruel. In the *Caraka-saṃhitā* we have a series of formulae for the preparation of gruels. It forms the latter half of the second chapter of the Sūtra Sthāna (vv. 15-31, pp. 13-14). It exactly agrees in substance though not in diction, with a similar series in the *Nāvanītaka* (vv. 786-801 ; ed., p. 62). In that treatise, however, the series is preceded by an additional formula (v. 785), and succeeded by the formula under discussion (No. 14, v. 802), to both of which formulae (vv. 785 and 802) there is nothing equivalent in the *Caraka-saṃhitā*. It suggests itself that the author of the *Nāvanītaka* may have extracted his series of formulae from the *Bheḍa-saṃhitā*, and added to it the formula under discussion (i.e., v. 802 of No. 14) from the floating medical tradition.

The fact of this addition he indicated by stating in the colophon that it was a *Bheli-yavāgū*, or a gruel (devised) by Bheḍa. The source of the preceding series of formulae he did not trouble to specify, because they were drawn from a well-known standard compilation. Unfortunately the secand chapter of the Sūtra Sthāna is missing in the Tanjore MS, and it is thus impossible to verify the truth of this hypothesis. It may be added that it is quite possible that some more of the formulae in the *Nāvanītaka* might have been found in the *Bheḍa-saṃhitā* if we possessed a complete copy of that work.

We may now proceed to the consideration of those formulae which are quoted from the *Caraka-saṃhitā*. They number twenty-eight, and are shown in the subjoined list :

(1) Tālīsaka-cūrṇa, or the *Taxus baccata* powder, vv. 11-13 (ed., p. 26); in CS, vi, 8, vv. 140-3 (p. 530).

(2) Ṣāḍava-cūrṇa, or confection powder, vv. 14-17 (ed., pp. 26-7); in CS., vi, 8, vv. 136-9 (p. 529).

(3) Vardhamānaka-cūrṇa, or graduated powder, vv. 25-6 (ed., p. 27); in CS., vi, 8, vv. 101-3 (p. 526).

(4) Mātuluṅga-cūrṇa, or citron powder, vv. 29-34 (ed., p. 27); in CS, vi, 5, vv. 75-80 (pp. 489-90).

(5) Tiktaka-ghṛta, or bitter ghee, vv. 133-6 (ed., p. 33); in CS., vi, 7, vv. 137-40 (pp. 515-16).

(6) Mahātiktaka-ghṛta, or great bitter ghee, vv. 137-43 (ed., p. 33); in CS., vi, 7, vv. 141-7 (p. 515).

(7) Ṣaṭpala-ghṛta, or six-*pala* ghee, vv. 150-1 (ed., p.34); in CS., vi, 5, vv. 143-4 (p. 495).

(8) Tryūṣaṇa-ghṛta, or treble acid ghee, v. 152 (ed. p. 34); in CS., vi, 5, v. 62 (p. 488).

(9) Vāsā-ghṛta, or *Adhatoda vasica* ghee, vv. 153-4 (ed., p. 34). in CS., vi, 5, vv. 122-3 (pp. 493-4).

(10) Cāṅgerī-ghṛta, or *Oxalis corniculata* ghee, vv. 155-7 (ed., p. 34); in CS., vi, 9, vv. 110-12 (p. 544).

(11) Śāramūlīya-ghṛta, or *Saccharum Sara* root ghee, vv. 169b-76 (ed., p. 35); in CS., vi, 2, vv. 23-31 (pp. 434-5).

(12) Cyavana-prāśa-ghṛta, or Cyavana-food ghee, vv. 188-200 (ed., p. 36); in CS., vi, 1, vv. 59-71 (pp. 413-14).

(13) Jvara-hara-anuvāsana-taila, or antifebrile oily enema, vv. 383-5 (ed., p. 45); in CS., vi, 3, vv. 245-6 (p. 466).

(14) Anuvāsana.taila, or an oily enema, vv. 386-9 (ed., p. 45); in CS., vi, 9, vv. 131-4 (p. 546).

(15) An unnamed cough mixture, vv. 460-2 (ed., p. 49); in CS., vi, 5, vv. 119-21 (p. 493).

(16) Prastha-vireka, or the *prastha* purgative, vv. 484-90 (ed., pp. 50-1); in CS., vi, 5, vv.150-6 (p. 496).

(17) Madhvāsava-yoga, or honey-liquor formula, vv. 491-3 (ed., p. 51); in CS., vi, 6, vv. 39-42 (p. 502)

(18) An unnamed fever mixture, vv. 494-5a (ed., p. 51); in CS., vi, 3, vv. 201-2a (p. 462).

(19) Another unnamed fever mixture, vv. 496b-9a (ed., p. 51); in CS., vi, 3, vv. 196-8 (p. 462).

(20) Prameha-praśamana-yoga, or prescription for the relief of morbid secretion of urine, v. 603 (ed., p. 56), in CS., vi, 6, 24 (p. 501).

(21) Picchā-vasti, or Bombax Malabarica enema, vv. 645-9 (ed., p. 58); in CS., vi, 10, vv. 70-4 (p. 563).

(22) An unnamed tonic mixture, vv. 742-3 (ed., p. 59); in CS., vi, 1, vv. 130-1 (p. 423).

(23) Pippalī-prayoga, or pepper prescription, vv. 745-8 (ed., pp. 59-60); in CS., vi, 1, vv. 132-5 (p. 423).

(24) Dvitīya-Pippalī-prayoga, or another pepper prescription, vv. 749-52 (ed., p. 60); in CS., vi, 1, vv. 136-40 (pp. 423-4). This is the so-called *pippalī-sahasra*, or thousand pepper tonic.

(25) An unnamed aphrodisiac formula, v. 819 (ed., p. 64); in CS., vi, 2, v. 99 (p. 441).

(26 and 27) Two other unnamed aphrodisiac formulae, vv. 844 b-6 a (ed., p. 65); in CS., vi, 2, vv. 44-5 (p. 436).

(28) Śilājatu-kalpa, or the preparation of bitumen, vv. 950-67 a (ed., pp. 70-1); in CS., vi, 1, vv. 148-64 (pp. 424-6).

With the exception of three, the text of all these twenty-eight formulae in the *Nāvanītaka* is practically identical with that which is printed in the modern Indian editions of the *Caraka-saṃhitā*. Occasional variants do occur, but they are all

of a kind that may be expected to arise in the long course of literary transmission. And indeed in not a few cases the variants of the *Bower MS.* are supported by the Nepal MS. of 1183 A.D., the oldest existing MS. of the *Caraka-saṃhitā*. The three exceptions are Nos. 1, 16, and 24. In Nos. 1 and 24 the Caraka text includes an additional verse. This may have accidentally dropped out in the *Nāvanītaka*, for the text of the latter is by no means free from scribal errors. In the case of No. 16 there are some serious textual differences, but as even some of these are supported by the Nepal MS. there is no good reason to exclude that formula from the list of those quoted by the author of the *Nāvanītaka* from the text of the *Caraka-saṃhitā* as known to him. Rather the *Nāvanītaka* may be taken as good evidence of the original constitution of the Caraka text.

As regards the names of the formulae, it may be noted that none of them is found in the oldest Caraka MSS., such as the Nepalese and Tübingen No. 458. The oldest witness to their use is the *Nāvanītaka;* and it would seem doubtful in most cases whether they really go back to Caraka himself. Sometimes the name varies. For example, in the case of No. 4, which in the *Nāvanītaka* is named *mātuluṅga-cūrṇa*, the printed editions of the *Caraka-saṃhitā* have the name *hingv-ādi-cūrṇa*, or powder made of asafoetida and other ingredients. This name does not occur in any Caraka MS. known to me. It appears first, I believe, in the *Cikitsā-saṃgraha* (ch. xxx, No. 27, p. 344) of Cakrapāṇidatta (the well-known Caraka commentator, c. 1060 A.D.), and is probably due to him, so that it would appear that the name *mātuluṅga-cūrṇa* was not known to him, and that the *Caraka-saṃhitā* MSS. in his time (as indeed shown by the contemporary Nepal MS.) contained no recognized names.[18] The case of No. 5 *(tiktaka-ghṛta)* and No. 6 *(mahātiktaka)* is particularly instructive with regard to the possible origin of these names. In the Caraka MSS. they are not found at all. Cakrapāṇidatta (C. CS., ch. 1, no. 69, pp. 491-2) calls No. 2 *tikta-*

18. Nāv., v. 135b (equal to CS., V. 139b), says *nava-sarpiṣaś-ca ṣaṭpalam -etat-siddhaṃ ghṛtaṃ peyam*, i.e. eight pala-s of fresh ghee (boiled with the previously mentioned drugs) makes an approved ghee for drinking.

ṣaṭpalaka and No. 6 *mahātiktaka* (his No. 72), but he has also a *pañcatikta* (his No 70), and a simple *tiktaka* (his No. 71). Now it may be noted that the text of No. 5 [19] implies that it is a *ṣaṭpala* formula. This explains why the *Nāvanītaka* calls it the *tiktaka* formula, to distinguish it from No. 7, the *ṣaṭpala* formula usually so called, and why Cakrapāṇi calls it *tikta-ṣaṭpala*, to distinguish it from his other *tiktaka* formulae. Further, the final words in our Nos. 5 and 6, which present the oldest form of the text of those two formulae, are *siddham* and *mahāsarpiḥ* respectively. In the old Nepal MS. they are *siddham* and *mahātiktam*, and in Cakrapāṇi, *siddham* and *mahātiktakam*, but in the modern MSS., as well as in the printed editions, they are *tiktam* and *mahātiktam*. This would seem to show that our No. 6 received its name, *mahātiktaka*, from its final word *mahāsarpiḥ*, to distinguish it from the simple *tiktaka;* and that finally the reading of the closing words of the two formulae was altered to conform to the names by which they had gradually come to be known. At the same time it would seem that at least the name *mahātiktaka* must go back to the time of Caraka, because we find the formula referred to under that name in his chapter on *visarpa*.

Caraka's Compendium, as we know, in the last resort represents the teaching of Ātreya. The above-listed twentyeight formulae, therefore, are to be taken as composed by Ātreya. There is nothing in the text of the formulae to refer them to Ātreya, nor does the *Nāvanītaka* indicate that reference by any remark of its own in a colophon or otherwise. It is only the fact of their being quoted from the *Caraka-saṃhitā* which indicates to us their authorship. But in addition to the twenty-eight there are six other formulae, which are not found in the *Caraka-saṃhitā*, but which the *Nāvanītaka* explicitly refers to Ātreya. These are the following :

(29) Laguḍa-cūrṇa, or *Holarrkena antidysenterica* (?) powder, vv. 35-7 (ed., p. 28); said in the final verse to be *Ātreya-juṣṭa*, or favoured by Ātreya.

19. Another plumbago-root formula, in *Bower MS.*, Part III, vv. 25-36a, is also ascribed to Ātreya.

(30) Śārdūla-cūrṇa, or plumbago-root powder, vv. 71-5a (ed., p. 30); said in the final verse to be *Ātreya-vihita*, or devised by Ātreya.[20]

(31) Amṛta-prāśa-ghṛta, or ambrosial-food ghee, vv. 108-19a (ed., p. 32); said in the final verse to be *Ātreya-nirmita*, or composed by Ātreya; also in the introductory verse.

(32) Mahākalyāṇaka-ghṛta, or the most efficacious ghee, vv. 127b-32 (ed., p. 33); said in the final verse to be *Ātreya-nirdiṣṭa*, or declared by Ātreya.

(33) Balā-taila, or *Sida cordifolia* oil, vv. 261-76 (ed. pp. 39-40); said in the introductory verse to be *Ātreyānumata*, or approved by Ātreya.

(34) A mutilated formula, v. 715 (ed., p. 58), which ends with the (prose) phrase *ity-āha bhagavān-Ātreyaḥ*, so spake the blessed Ātreya.

The first of these six formula (No. 29) is, for the present, not treaceable elsewhere. But the second formula (No. 30) is found, though with a characteristic difference, in Mādhava's *Siddhayoga* (ch. vi on *ajīrṇa*, indigestion, vv. 27-32, p. 114). In substance it is identical throughout. Even in diction it runs identically in the initial three half-verses. At this point an additional ingredient *(kuṣṭha)* is introduced, and thenceforward to the end of the formula the diction is quite different. Also the reference to Ātreya is omitted, and the formula is given the different but synonymous name *agnimukha-cūrṇa*. This modified recension is quoted by Cakrapāṇidatta (C.CS, vi, No. 17, pp. 131-2) and Vaṅgasena (V. CS., v, vv. 56-60, p. 187). In the *Caraka-saṃhitā* neither the original nor the modified formula is found; in fact, that Compendium includes no special chapter on *ajīrṇa* complaints, for which the formula is designed. It would almost seem that the author of the modified formula is Mādhava himself, who accordingly omitted the reference to Ātreya and altered its name. I may add that I learn from Dr. Cordier (letter, October 25, 1904) that the original formula (reading as in the *Nāvanītaka,* though with a few variants) is found in the

20. A work called *Vaidya-prasāraka* is respeatedly mentioned in Śrīkaṇṭha's Commentary to the *Siddhayoga*, e.g. pp. 137, 157, 313, etc.

second chapter of an anonymous treatise called *Bṛhad-vaidya-prasāraka.*[21] The third, fourth, and fifth formulae (Nos. 31, 32, and 33) occur with the same names in the *Caraka-saṃhitā*, in the *kṣata-kṣīṇa*, *unmāda*, and *vātavyādhi* chapters respectively (CS, vi, 16, vv. 32-40, pp. 624-5; 14, vv. 53-4, p. 612; 28, vv. 144-52, p. 783). But here, though practically identical in substance, they appear in an entirely different version; nor are these versions attributed to Ātreya.[22]

The preceding list of thirty-four formulae in its totality suggests some important considerations. We have in it two series : one consisting of twenty-eight formulae, of none of which the author of the *Nāvanītaka* indicates any source, and another series of six formulae, all of which he explicitly attributes to Ātreya. Yet we know from the fact of the former series occurring in the *Caraka-saṃhitā* that those twenty-eight formulae are also ultimately due to the authorship of Ātreya. Why should the author of the *Nāvanītaka* make such a striking distinction in quoting them ? The explanation which suggests itself is that he does so precisely because he takes the longer series from a well-known standard book of his time, while he quotes the

21. Nor are they so attributed in Vāgbhaṭa I's *Aṣṭāṅga Saṃgraha* (iv. 5, ll. 8ff., p. 26 ; vi, 9, ll. 5-7, p. 214 ; iv. 23, ll. 16 ff, p. 130), whence they appear to be quoted, with some variants, by Dṛḍhabala, the complementor of the *Caraka-saṃhitā*. In the case of the third formula (No. 31), while the second half is identical with the *Caraka* version (vv. 38-40), the first half, though identical in substance, differs in diction. In the case of the fifth formula (No. 33), the Jiv. ed. of 1896 appends a final half-line (CS., vi, 28, v. 152b, p. 783) ascribing the formulae to Kṛṣṇātreya. But this is a spurious addition ; it is wanting in all MSS and all editions (even Jiv.'s own ed. of 1877), except that of Gaṅgādhara, who may have been himself the author of it. There is a similar spurious addition to the *navāyasa-cūrṇa* in Jiv. ed. 1896, p. 680, v. 69b, ascribing it to Kṛṣṇātreya. It, too, is wanting in all MSS. and in most editions, even Jiv. 1877. It first appears in Gaṅgādhara's ed. (1881), p. 377, whence it is taken into the Sena ed. (1897), p. 738. It is also taken into the Sena ed. of Cakrapāṇi's *Cikitsā Saṃgraha* (1889), No. 8, p. 149; but it is wanting in the Pyari Mohan ed. (1879), p. 170. It is also wanting in the *Siddhayoga*, p. 124.

22. See also *Bower MS.*, Part I, vv. 61-7, for an *Agastya* formula.

shorter series from what we may call provisionally the floating medical tradition. In the former case there was no need for him to specify the source, because it was well-known to everybody that Ātreya was the ultimate source of the *Caraka-saṃhitā* But when he took a formula from the floating tradition we can understand that he thought it necessary to assure the reader as to his authority for recommending a certain recipe. Thus when he quotes the *balā* oil (No. 33) he prefaces it with the remark that he is going to describe an oil which has been recommended by Ātreya for the cure of nervous diseases and female complaints. With a similar remark he introduces the description of the ambrosial ghee (No. 31), and his description he winds up by once more saying that this famous *(vikhyāta)* ghee was devised by Ātreya. As observed (*JRAS.* 1909. 863), he in a similar manner introduces and winds up the *raktapitta* formula (No. 10, *Ib.*, p. 862), which he quotes from the floating tradition as a composition of the Aśvins. Similarly he recommends his *laguḍa* and *śārdūla* powders and his *mahākalyāṇa* ghee (Nos. 29, 30, and 32, *Ib.*, pp. 874-5) by a reference to Ātreya's authorship. As regards the mutilated statement (No. 34), the phrase with which it winds up, *ity-āha bhagavān-Ātreya*, so spake the blessed Ātreya, is a formula which is distinctive of the most ancient medical works (Tantra or Saṃhitā). It occurs, e.g., at the beginning of every chapter of the *Caraka-saṃhitā* and *Bheḍa-saṃhitā*. It is unfortunate that owing to the loss of two folios (20th and 21st) of the *Bower MS.* the identity of the work from which the extract was made cannot be determined.

We have in the *Nāvanītaka* a considerable number of other such quotations from the floating tradition. Thus single formulae are quoted under the names of Kāṅkāyana (v. 935, ed., p. 69), Nimi (vv. 883-4, p. 67), Uśanas (vv. 846-7a, p. 65), Vāḍvali (vv. 319-24, p. 42), Bṛhaspati (prose 784, p. 61). Two formulae each are referred to Agastya (vv. 588-9, p. 55, and vv. 905-9 p. 68)[23] : Dhanvantari (vv. 232-40, p. 38 and vv. 968-76, p. 71) and Jīvaka (v. 1081 and vv. 1097b-9a, pp. 74-5). Finally, a whole series of formulae are referred to Kāśyapa

23. Or Kaśyapa; the spelling varies in the MSS.

(vv. 1011-40, pp. 71-3 specially vv. 1020, 1022, 1027).

The most noteworthy point in this list is its archaic character. Most of the names belong to semi-mythic or prehistoric personages. Vāḍvali, I believe, is even unknown outside the *Nāvanītaka*. None of the formulae included in the list, with one exception, can, so far as I know, be traced elsewhere; and the single exception (v. 1081), which qouted by Vaṅgasena (ch. lxix, v. 68, p. 895) in a nearly identical version, but without naming its author, belongs to Jīvaka, who is the only historical, or perhaps rather semi-historical, person in the list. He is the traditional court physician of King Ajātaśatru, and a contemporary of Buddha. The *Nāvanītaka* is the only work that actually cites formulae ascribed to him by name. He is reputed to have been a children's doctor, and the formulae quoted from him do refer to children's diseases (see also *infra*). Kāśyapa[24] is probably also an historical person, and likewise a contemporary of Buddha. The medical tradition knows of two men of that name, an older *(vṛddha)*, and a younger. It is Kāśyapa the older, no doubt, whom the *Nāvanītaka* quotes. He, too, is reputed to have been a children's doctor, and a long series of "Kāśyapīya pills" (see the colphon to v. 1040) for children's diseases are ascribed to him. Vāgbhaṭa I (AS, vi, 2, 1·1, 182, and vi, 4, 1-24, p. 190, footnote)[25] also quotes two of the older Kāśyapa's formulae against infantile diseases.

With regard to this older Kāśyapa, we have a curious piece of evidence in an old MS. discovered by Mahāmahopādhyāya Hara Prasāda Śāstrī in the Nepal Durbar Library *(Report*, Calcutta, 1901, and *Rec. Dec.*, p. 2). One portion of the MS. contains a chapter called Bhaiṣajyopakramaṇīya, or "The Use of Medicaments", which commences with the phrase *iti ha smāha*

24. Also quoted by Vāgbhaṭa II in AH., vi, 2, vv. 41-3a, and vi, 3, vv. 48b, 49a.

25. If so, it would be a chapter of the Sūtra Sthāna; cf. the name *bheṣajāvacaraṇīya* of the thirteenth chapter of the Sūtra Sthāna in Vāgbhaṭa I's *Aṣṭāṅga Saṃgraha*.

bhagavān Kāśyapaḥ, thus spake the blessed Kāśyapa. This is the same formula which occurs in the *Nāvanītaka* with reference to Ātreya (No. 34), and it indicates that the chapter belongs to some ancient Saṃhitā [26] or Tantra. It also occurs in the *Caraka-saṃhitā*, which is the earliest surviving Saṃhitā. That Saṃhitā professes to be based on an earlier *Agniveśa Tantra.* This points to the conclusion that the Saṃhitā (as indeed the name implies) does not represent the earliest stage of Indian medical literature, but that it was preceded by a still earlier stage, in which the separate branches, or special subjects, of medicine were dealt with in separate Tantra-s, or treatises, and special Kalpa-s, or monographs. Subsequently the contents of these Tantra-s and Kalpa-s were, in a compressed and selective form, compiled in Saṃhitā-s, or Compendia. We have thus two periods in the earlier medical literature of India, the Tantra-kalpa period and the Saṃhitā period. The medical tradition often refers to the former of the two periods. Thus we hear of a *Śalya-tantra*, or treatise on major surgery. This was the original work of Suśruta the older (the *vṛddha* Suśruta of the tradition), before it was revised and enlarged by the anonymous Suśruta the younger. By the latter it was brought into the form of the Compendium which we possess in the present day, and which therefore belongs to the Saṃhitā class of works, and to the later of the two periods. In fact, the very name *Uttara-tantra*,[27] or "later Tantra", which Suśruta the younger has given to his complementary part of the Compendium, implies that the original portion, which he revised and complemented, was the "early Tantra" of Suśruta the older, and by that name, viz. *Suśruta Śalya Tantra*, or Suśruta's treatise on major surgery, Suśruta the older's work is

26. In ch. I, v. 6, p. 658, he calls it a *mahat-tantra*, or large Tantra, because it comprises rather more than one third of the whole compendium.

27. This is the explanation of Ḍallaṇa (D. NS., p. 938), and is no doubt correct. He refers, merely to reject it as spurious, to another explanation which identifies Videhapati with Janaka. He does not name the author of this spurious explanation; but the author is Candraṭa, who actually introduced his explanation into the text of Suśruta. These spurious verses of Candraṭa may be seen in the *Ind. Off. MS.*, No. 1842 (Cat. 2646), fol. Ia, vv. 6-8a.

still called in the commentary of Gayadāsa (see Dr. Cordier in *Rec. Dec.*, p. 13). In the introduction to his *Uttara-tantra* (ch. 1, vv. 1-7, p. 658), Suśruta the younger refers to a number of Tantras, or treatises, which he consulted for the preparation of his own work, and he thus shows that he himself has to be placed in the second, or Saṃhitā, period of the early medical literature. Among the works thus consulted he names a work on *Śālākya*, or minor surgery, by Videhapati, or the lord of Videha; also works on *kumār-ābādha*, or children's diseases, and the works on *kāya-cikitsā*, or internal medicine, by the six pupils of Ātreya. The *Śālākya-tantra* here referred to must be that traditionally credited to Nimi, the king of Videha, and reported founder of ophthalmic medicine, who is quoted in the *Nāvanītaka*.[28] Among the *Kaumāra-tantra*-s may have been those of Jīvaka and Kāśyapa, who are named in the *Nāvanītaka*. The commentator Ḍallaṇa (D. NS., p. 938) actually mentions Jīvaka along with two others, Pārvataka and Bandhaka, who are not otherwise known. Among the works on internal medicine must have been the Tantra-s of Agniveśa and of Bheḍa, on which the still existing Saṃhitās of Caraka and Bheḍa are based. From the way the six treatises on internal medicine are mentioned by the author of the *Uttara-tantra*, it does not seem probable that he is referring to those two Saṃhitā-s, but rather to their sources, the Tantra-s, and hence it may be concluded that the *Uttara-tantra* is anterior to, or at most contemporaneous with, those two Saṃhitās. The other four pupils of Ātreya were Harīta, Jātūkarṇa, Kṣarapāṇi, and Parāśara. All four are often quoted in medical works of mediaeval India, but none of their treatises have survived. From the remark of the author of the *Uttara-tantra*, however, it would seem that they were still in existence in his time.[29]

28. On the Tantra literature; see also Dr. Cordier, *Rec. Dec.*, p. 18

29. In this connection it is worth observing that in the monograph on garlic *(laśuna-kalpa)*, *Bower MS.*, Part I, v. 9 (also v. 40), Suśruta is represented as the "hearer", or the recipient, of the instruction of the sage-king of Kāśī *(Kāśīrāja-muni)*. Notice also that here, too, the formula *atha sa bhagavān āha*, thus spake that blessed one, i.e. Kāsirāja, occurs.

Of the early Kalpa works, which were mostly monographs on pharmacological or pharmacopoeic subjects, we have several examples preserved in the *Nāvanītaka*. Thus we have a *Yavāgū-kalpa* on the preparation of gruels in the seventh chapter (vv. 785-813), which may have been a work of Bheḍa; a *Harītakī-kalpa* on chebulic myrobalan in the eleventh chapter (vv. 917-49, also called *Abhaya-kalpa* in v. 7), a very ancient monograph, ascribed to the Aśvins; a *Śilājatu-kalpa* on bitumen in the twelfth chapter (vv. 950-67), ascribed to Ātreya through Agniveśa and a *Citraka-kalpa* on the plumbago plant in the thirteenth chapter (vv. 968-76), ascribed to Dhanvantari. To these must be added the *Laśuna-kalpa*, which constitutes the earlier portion (vv. 1-43a) of Part I of the *Bower MSS*. In his *Rec. Dec.* (pp. 4, 15) Dr. Cordier reports the existence of two Kalpa works from fragmentary manuscripts in his possession—a *Bheṣaja-kalpa* on medicaments, by Bharadvāja, and a *Tāmbūla-kalpa* on betalleaf, by Vararuci. As the well-known formula *ity-āha bhagavān Bharadvājaḥ* (or *Vararuciḥ*), so spake the blessed Bharadvāja (or Vararuci), occurs in them, they are suggested by Dr. Cordier to belong to a *Bharadvāja Saṃhitā* and a *Vararuci Saṃhitā*. In that case, however, these two Saṃhitā-s could not belong to the class of genuine early Saṃhitā-s. For the genuine Saṃhitā-s do not bear the names of their ultimate sources. Both the *Caraka-saṃhitā* and the *Bheḍa-saṃhitā* have the formula *ity-āha bhagavān Ātreya*, thus spake the blessed Ātreya, and they thus refer themselves ultimately to Ātreya, but neither is called *Ātreya Saṃhitā*. There exists indeed an *Ātreya-saṃhitā*, but its apocryphal character is, I believe, generally admitted (thus by Dr. Cordier, *Rec. Dec.* p. 28). According to the Indian tradition, in fact, Ātreya did not himself commit his teaching to writing; it was done by his disciples Agniveśa, Bheḍa, and the rest. The *Hārīta-saṃhitā*, the *Āśvina-saṃhitā*, the *Kāśyapa-saṃhitā* are no doubt apocryphal compilations. All these apocryphal compendia do not belong to the early period of the medical literature, but to mediaeval and comparatively modern times. To this later time belong also some compendia, which, though they call themselves Saṃhitā, do not claim to belong to the early

period. Such are the *Aṣṭāṅga-hṛdaya-saṃhitā* of Vāgbhaṭa II (ninth century), and the *Siddhasāra-saṃhitā* of Ravigupta (Cordier, in *Rec. Dec.*, p. 16). To an intermediate period belongs the *Aṣṭāṅga-saṃgraha* of Vāgbhaṭa I (early seventh century), which by way of distinction calls itself, not a Saṃhitā, but a Saṃgraha, two practically synonymous terms. To the subsequent mediaeval period belong some other Saṃgraha works of a rather more restricted purport such as the *Cikitsā-saṃgraha* of Cakrapāṇidatta (c. 1060), the *Cikitsāsāra-saṃgraha* of Vaṅgasena (eleventh century), and probably the (anonymous ?) *Kalyāṇa-saṃgraha* (Cordier, *Rec. Dec.* p. 24). These are concerned only with pathology and therapeutics. Original works on medicine would thus seem to have practically ceased from the time of the early Saṃhitā-s. A new start would appear to have been made with the commencement of the later middle age, when the treatment with mercury *(rasa)* came into vogue. The earliest work of this period appears to be a Saṃhitā of the above-mentioned restricted character, which was composed by Śārṅgadeva probably in the twelfth century. Other works of this period prominently concerned with *rasa* will be found enumerated in Professor Jolly's *Indian Medicine* in the "Encyclopaedia of Indo-Aryan Research."

The chronological position of the *Uttara-tantra*, as being rather earlier than, or at most contemporary with, the *Caraka-saṃhitā*, has already been referred to. The point is of some importance because of its bearing on the determination of the date of the *Bheḍa-saṃhitā* and the *Nāvanītaka*. As regards the *Bheḍa-saṃhitā*, there occurs in it a reference to Suśrotā, the "learned" *(medhāvin)*, as the interlocutor of Cāndrabhāga, at the beginning of the fourteenth chapter of the Sūtra Sthāna. As Dr. Cordier, who first drew attention to the passage *(Orig.*, p. 80), rightly points out, the word *suśrotā* is descriptive, denoting "the good hearer" and would seem to be the correcter form of the more usual Suśruta, or "well-heard".[30] Also in

30. To show this in detail would exceed the limits of this paper. A brief statement must suffice. The aphrodisiac formulae are quoted in AS., vi. 50, p. 411; AH., vi. 40, vv. 23ff. ; C. CS., lxxi, No. 3, p. 726 ;

my previous paper (*JRAS* 1908, pp. 1020 ff. and 1024 ff.), it was shown that the doctrine of the blood-tumour *(rakta-gulma)* and of the five localities of the tumours do not occur in the teaching of Ātreya as represented by Caraka, but are peculiar to the *Uttara-tantra* of Suśruta the younger. Now the doctrine of the blood-tumour is distinctly taught in the *gulma* chapter of the *Bheḍa saṃhitā,* both in its Nidāna and Cikitsita Sthāna. The doctrine of the five localities, too, though this is not quite so clear, seems to be taught in its Cikitsita Sthāna. Both points would seem to combine to make the *Bheḍa-saṃhitā* posterior in date to the *Uttara-tantra.* Of course, it might be argued that the mention of Suśrotā refers to Suśruta the older, and that Suśruta the younger may have obtained his doctrines of the blood-tumour and the five localities from the *Bheḍa-saṃhitā,* though in the latter work the doctrine of the five localities is by no means certain, nor does Suśruta the younger seem to indicate any Saṃhitā among his sources. But what seems to render this alternative theory particularly improbable is that it would imply that Ātreya, to whom as, their ultimate source, both the *Bheḍa-saṃhitā* and the *Caraka-saṃhitā* appeal, taught contradictory doctrines.

As regards the *Nāvanītaka,* we have the following six parallelisms with the *Suśruta-saṃhitā* :

(1-3) Three Āmātisāra-yoga, or formulae for diarrhoea, verses 407-8, 409-10, and 411-12 (ed., pp. 46-7), corresponding to SS. vi, 40, vv. 35b-36a, 35a, and v. 46 (pp. 783-4).

(4-6) Three Vājīkaraṇa-yoga, or aphrodisiac formulae, verses 829-30a, 833b-4a, 834-5a (ed., p. 64), corresponding to SS., iv, 26, vv. 27, 20, 21 (pp. 518-19).

The former three parallels are from the *Uttara-tantra* of Suśruta the younger, while the latter three are from the earlier portion of Suśruta the older. In all of them the agreement with the text of the *Suśruta-saṃhitā,* as it now stands in our MSS. and editions, is not quite so perfect as one would wish. But it

V. CS., lxx, vv. 11 ff., p. 997. The textual aggreements and differences in these quotations, among themselves as well as with the *Nāvanītaka* versions, seem to point to the latter having preserved the original text.

is well known that that text has in the course of its transmission suffered very considerable alterations, so that it is quite possible that the versions as preserved in the *Nāvanītaka* may preserve the original text.[31] But what is more important is that the *Nāvanītaka* appears to quote the three Āmātisāra formulae (nos. 1-3), not directly from the *Uttara-tantra*, but from the *Bheḍa-saṃhitā*. For, as mentioned already they occur identically in the latter work. And what is specially significant, their identity shows itself not merely in the text of the formulae, but in the manner, common to both the *Nāvanītaka* and the *Bheḍa-saṃhitā*, of quoting from the *Uttara-tantra*. Indian prescriptions consist of two parts, a pharmaceutic and a directive; the former naming certain drugs, the latter explaining how to apply them. Now the *Uttara-tantra*, dealing with the treatment of *atisāra* (diarrhoea), gives, *inter alia*, a long prescription consisting of twenty pharmaceutic options (each in half a verse), together with a single directive statement (SS. vi, 40, vv. 33-45). The *Nāvanītaka*, equally with the *Bheḍa-śaṃhitā*, selects three of these twenty options and forms them into two separate prescriptions, each with its own directive statement, viz., *Nāv*., v. 407a, b =SS, v. 35b and v. 36a plus directive v. 408; also *Nāv*., v. 409a=SS. v. 35a plus directive vv. 40a, b, 41a.

This state of things naturally suggests chronological inferences. The most obvious of these, though perhaps not yet absolutely certain, appears to me to be that the *Nāvanītaka* quotes from the *Bheḍa-saṃhitā*, and that the latter bases itself on the *Uttara-tantra*, and therefore that the *Nāvanītaka* is posterior to the *Bheḍa-saṃhitā* and *a fortiori* later than the *Uttara-tantra* of Suśruta the younger. Regarding the chronological priority of the latter to the *Bheḍa-saṃhitā*, it has already been shown that

31. For a summary of these theories see *JRAS*, 1908, pp. 1 ff. and IA., xxxvii (1908), pp. 25 ff. On the whole, though I agree with Professor Rapson (*Brit. Mus. Cat. of the Coins of the Andhra, etc., Dynasties*, introd., pp. cv, cvi) that "the name of the [Śaka] era ... may have been derived from the [Western Kṣatrapa, Śaka] Kings who used it rather than from the [Kuṣāna] King [Kaniṣka] who established it", I am now disposed to believe that the Vikrama theory offers the true solution of the problem.

the Saṃhitā names Suśrotā (Suśruta) and knows his doctrines on *gulma*. Likewise, it has been shown that the *Uttara-tantra* is anterior to, or at most contemporaneous with, the Caraka-saṃhitā, and that the *Nāvanītaka* quotes from the latter Saṃhitā. It follows from all these premises that the *Nāvanītaka* is posterior to both the Compendium of Bheḍa and the Compendium of Caraka. Moreover, we must take it that a considerable interval of time must have elapsed between the *Nāvanītaka* and those two Compendia in order to allow the latter to reach that position of acknowledged standard works which enabled the author of the *Nāvanītaka* to quote from them without naming his sources. As already observed it is this manner of anonymously quoting from them which, in addition to the identity of the quoted passages, shows that the quotations cannot be from the floating tradition respecting the doctrines of Ātreya (handed down by Agniveśa and Bheḍa), but that they must really be from the (still existing) two Compendia of Caraka and Bheḍa. With respect to the *Caraka-saṃhitā* more particularly, there is the additional argument suggested by the curious circumstance to be discussed presently, that the quotations are all made from portions of the Saṃhitā traditionally ascribed to Caraka's authorship, there being no quotations at all from any portion attributed to Dṛḍhabala. The point I wish to make is that though each of the above-mentioned facts taken by itself need not be conclusive, combination present an argument of great force in favour of the *Nāvanītaka* being later in date than the *Caraka-saṃhitā*, and of the latter work (in the form in which it at the time existed, before its revision and completion by Dṛḍhabala) having been one of the sources drawn on by the author of the *Nāvanītaka*.

The date of the *Caraka-saṃhitā* itself is uncertain. It depends on the view one takes of the date of Kaniṣka, whose contemporary Caraka is traditionally said to have been. This is not to the place to discuss the intricacies of this vexed question. In the main there are three rival theories. One connects Kaniṣka with the so-called Vikrama era in 58 B.C,, another connects him with the Śakā era in 78 A.D., the third places

him about 123 A.D.[32] These theories fix the upper limit. The lower limit is fixed by the *Bower MS.*, which must have been written in the second half of the fourth century A.D. Between these two limits the composition of the *Nāvanītaka* has to be placed. One cannot help feeling disappointed that a more definite date cannot be determined. For myself, I am disposed to place it in the second or third century A.D. In favour of such an early date there are, in addition to the general considerations above set out, special marks of archaism observable in the *Nāvanītaka*. It would take me too long to enter fully into this subject, but I may instance the archaic genitive plural *varadāṃ* in verse 774 (see n. 171 on p. 61 of my edition), and the archaic version of the *pippalī-vardhamāna* formula referred to above.

Coming now to the question of the condition of the *Caraka-saṃhitā* at the date of the *Nāvanītaka*, in the subjoined Table the quotations from the *Caraka-saṃhitā*, which are enumerated in JRAS, 1908 are arranged in the order of the chapters of the *Cikitsita Sthāna*.

28-Series	30-Series	Name of Chapter	Nos. in List on pp. 871-2
	1	Rasāyana	Nos. 12, 22-4, 28
	2	Vājikaraṇa	Nos. 11, 25-7
1	3	Jvara	Nos. 13, 18, 19
2	4	Raktapitta	(No. 9)
3	5	Gulma	Nos. 4, 7, 8 (9), 15, 16
4	6	Prameha	Nos. 17, 20
5	7	Kuṣṭha	Nos. 5, 6*
6	8	Yakṣman	Nos. 1-3
7	9	Arśas	Nos. 10, 14
8	10	Atisāra	No. 21
9	11	Visarpa	Mahātiktaka (No. 6)

32. In a third recension it is quoted in AS., iv, 2, and AH., iv, 2 on *raktapitta*.

Comparing this Table with that given on p. 1000 in JRAS 1908, it will be observed that the order of the chapters as shown in the present Table agrees with that of the traditional series shown in column I of the previous Table. The conclusion suggested by this argeement is that the Cikitsita Sthāna of the *Caraka-saṃhitā*, as known to the author of the *Nāvanītaka*, consisted only of the thirteen (respectively elevan) chapters shown in column I, and that the remaining seventeen chapters (14-30, or 12-28) did not exist in his time, but were added subsequently by Dṛḍhabala. It is true that the formula No. 9, which in the Table is shown for the chapter on *raktapitta*, is in the existing text of the *Caraka-saṃhitā* found in the fifth chapter (vv. I22-3, pp. 493-4) on *gulma*. But the same *vāsa-ghṛta* formula, though in a different recension, is given by the *Caraka-saṃhitā* also in its fourth chapter (v.86) on *raktapitta*, and this alternative recension is that which is usually quoted in all medical works, e.g., M.S., ix, 39, 40, p. 135; C. CS., ix, 33, p. 164; V.CS., viii, 120 121, p. 229. It does not seem impossible that the recension which now stands in the gulma chapter originally stood in the *raktapitta* chapter, from which it came to be extruded by the other recension which now takes its place. For it is worth noticing that the text of this usurping recension is still unsettled in the existing MSS. It seems properly to consist of two verses, of which, however, the second is omitted in all the existing printed editions. Among the existing (and to me accessible) MSS., the second verse is found in the old Nepal MS., also in Tüb. 458 and I.O. 359. while in Tüb. 459, I.O. 335, and Decc. 925 it is missing. For the existence of the same discrepancy in the MSS. of (probably) the thirteenth century we have the testimony of Śivadāsa, who in his commentary on Cakrapāṇidatta's *Cikītsā-saṃgraha* (ix. 33), states that some *(kecit)* add the second verse to the formula.

With regard to the eleventh (respectively ninth) chapter on *visarpa*, the *Nāvanītaka* in its surviving mutilated condition contains no actual quotation, but in verse 613 it recommends the *mahātiktaka ghee* as a remedy for erysipelas. This particular *ghee* the *Nāvanītaka* had already quoted (vv. 137-43) from the

Caraka-saṃhitā as a remedy against skin diseases *(kuṣṭha)*. Turning to that Saṃhitā, we find that in verse 61 of its chapter on *visarpa* it expressly states that the *mahātiktaka ghee*, previously mentioned as a remedy for skin diseases, may also be administered to cure erysipelas. On the other hand, the *Bheḍa-saṃhitā*, while it mentions several remedies (e.g. the *Balā* oil and the *dhānvantara* ghee),[33] does not name among them the *mahātiktaka* ghee. From this it may justly be concluded that the author of the *Nāvanītaka* had the *visarpa* chapter in his copy of the *Caraka-saṃhitā*, and thence derived his recommendation.

It is true that the *Nāvanītaka* gives us no quotations from the two chapters on *madātyaya* and *dvivraṇīya*. But in their case, too, as in that of the chapter on *visarpa*, we must remember that the *Nāvanītaka* MS. is not complete. Its fols. 16 and 17 are mere fragments, and fols. 20 and 21, as well as an unknown number (perhaps five) after fol. 33 are altogether missing. Thus we are deprived of a large portion of the fourth chapter on "Miscellaneous Formulae", and of the fifth chapter on "Enemas", also of the whole of the fifteenth and sixteenth chapters on the treatment of barren and polific women. These missing portions might very well have contained quotations from those three chapters.[34]

So far we have had the positive evidence of the *Nāvanītaka* with respect to the question of the authorship of the *Caraka-saṃhitā*. We may now turn to its negative testimony. It contains three formulae (Nos. 31, 32, 33, on p. 875) for the cure of *kṣata-kṣīṇa, unmāda,* and *vātavyādhi*, or consumptive, mental, and rheumatic diseases respectively, which are attributed to Ātreya. As previously explained, the author of the *Nāvanītaka* must have obtained them from the floating medical tradition of his time,

33. The *Nāvanītaka*, vv. 232-40, too, has a *dhānvantara* ghee as remedy for skin diseases, and it may have got this formula from the *Bheḍasaṃhitā*, though in the existing mutilated copy of the latter it cannot be traced.

34. As to the chapter on *dvivraṇīya*, it may be observed that it is quoted by name in the *Caraka-saṃhitā*, in the 137th verse of the chapter on *visarpa* (p. 581). If Caraka was the author of the latter chapter he must, *prima facie* at least, have been also the author of the former.

for though corresponding formulae do occur in the existing *Caraka-saṃhitā* their recension is entirely different, and they are not attributed to Ātreya. It follows that at the date of the *Nāvanītaka* the chapters on *kṣata-kṣīṇa*, *unmāda*, and *vātavyādhi*, in which those corresponding formulae are found, cannot have formed part of the *Caraka-saṃhitā*, otherwise the author of the *Nāvanītaka* would have quoted their recensions of the formulae in question instead of those which he actually quotes. In other words, it follows that those three chapters must belong to the additions which were made by Dṛḍhabala. As a matter of fact (see the Table on p. 1000 in JRAS 1908), both traditional series agree in attributing at least the chapter on *vātavyādhi* to Dṛḍhabala. Regarding the authorship of the two chapters on *kṣata-kṣīṇa* and *unmāda* the two series differ, and here the negative testimony of the *Nāvanītaka* is in favour of the series in column I, thus confirming the effect of its positive evidence.

At this point a passage is worth noticing which has been discussed by me in the *Archiv für die Geschichte der Medizin,* Band i, Heft i, pp. 38-9. I refer to verse 17la in the chapter on *arśa*-s (CS., p. 549). Of this verse, according to the testimony of Vijaya Rakṣita, the commentator on Mādhava's *Nidāna* (MN., p. 71), there exists a variant form in the so-called Kashmir Recension of the *Caraka-saṃhitā.* That recension is with good reason to be ascribed to Dṛḍhabala, and the existence of the variant tends to show that the original form of the verse, and consequently the chapter on *arśa*-s, is the work of Caraka.

The testimony of the *Nāvanītaka,* considering its very early age, naturally carries so great weight that it does seem to finally settle the question of the original condition of the *Carak-saṃhitā* in favour of that traditional order, which is shown in column I of the Table (*JRAS*, 1908, p. 1000), and which is adopted in the edition of Jīvānanda. If that is so, the further question arises how are the two arguments for the other side (*ibid.*, pp 1017-19) to be met. The first argument is that in verse 157, p. 496, of the chapter on *gulma*, Dṛḍhabala seems to indicate himself as the author of the chapter on *arśa*-s, no less than of the chapter on *grahaṇī,* and of the *Siddhi Sthāna,* both of which

are admittedly his compositions. If, as it now appears, the testimony of the *Nāvanītaka* must prevail, we must assume that the verse (157), as it now stands, has been modified in the course of Dṛḍhabala's revision, and that in its original form, as written by Caraka, it contained a reference to the chapter on *arśa*-s alone, to which Dṛḍhabala added the further references to his own chapter on *grahaṇī* and his own Siddhi Sthāna. Of course, there is no intrinsic difficulty in this explanation. For the fact that Dṛḍhabala has not infrequently interfered with Caraka's text has been shown abundantly. It can be also shown that Caraka not infrequently refers the reader for further information to some other chapter of his. Thus in the chapter on *visarpa*, which, as we have seen, the testimony of the *Nāvanītaka* attributes to Caraka, the latter twice (vv. 61, 130) refers to his undoubted chapter on *gulma*,[35] and once (v. 137) to his chapter on *dvivraṇīya*.

The second argument is concerned with the position of the two chapters on *unmāda* and *apasmāra*. These chapters in Gaṅgādhara's series (column II of the Table on p.1000) stand in the same sequence as in the Nidāna Sthāna, which is admittedly the composition of Caraka, while in Jīvānanda's series they occupy a very different place. And the argument is that Caraka must have written those two chapters because he would have kept his own sequence. This is a view which naturally suggests itself, but, of course, it is not necessarily conclusive, for we really know nothing as to Caraka's ways of writing, whether and why he may have written any one chapter before or after another. On this point there is a curious indication in the chapter on *visarpa*. In the 137th verse of that chapter, we find a reference to the chapter on *dvivraṇīya*. This would naturally lead one to conclude that the chapter on *dvivraṇīya* was written before the chapter on *visarpa*. Yet in the existing series it follows the latter chapter; for the chapter on *visarpa* is the eleventh (respectively ninth), while that on *dvivraṇīya* is the thirteenth (respectively eleventh). If we may assume that the

35. The reference in v. 61 (p. 575) is to the *trāyamāṇā* ghee, which is described in the chapter on *gulma*, vv. 114-17 (p. 493).

existing sequence of the chapters proceeds from the hand of Caraka, and that he was, as the testimony of the *Nāvanītaka* clearly indicates, the author of the two chapters in question, it is evident that he did not always place the chapters in the order in which he wrote them. It is quite possible, therefore, that Caraka wrote the chapter on *arśa*-s, as well as the other four chapters on *atisāra, visarpa, madātyaya,* and *dvivraṇīya,* before proceeding to write on *unmāda* and *apasmāra.* As a matter of fact, he never came to write on the latter two subjects, or if he did write on them, the two chapters are irretrievably lost. It is also quite possible that if Caraka had been spared to write all the chapters which he probably, or possibly, intended to write, he would, after the completion of his task, have arranged the chapters in the *Nidāna* and *Cikitsita Sthāna* so as to preserve the same sequence. But, after all, these are idle speculations, with no cogency as that of the *Nāvanītaka.* On the other hand, it may be suggested with much plausibility that this very question of the apparently inconsistent position of the chapters within the series may account for the origination of the traditional series which, for the purpose of introducing consistency, places the chapters on *unmāda* and *apasmāra* immediately after the chapter on *yakṣman;* though there still remain the numerous other discrepancies between the two traditional series to be accounted for. So long as all these discrepancies are not satisfactorily explained, one cannot help feeling that some uncertainty still remains as to finality having been reached in the unravelment of the problem of the authorship of the several parts of the *Caraka-saṃhitā.*

PHYSICIANS AND THERAPY

J. JOLLY

TRAINING OF PHYSICIANS

In the choice of a teacher[1] the future physician should be cautious and should approach a person who is experienced both in theory and practice, is clever and blameless, has got control over his hand, has the necessary means and materials (of relief) and possesses friendly behaviour. Similarly a teacher should accept as a pupil only a young man from good family, especially from a family of physicians, intelligent, courageous and devoted to his teacher and one who has good memory and other qualities. The beginning of instruction is preceded by a consecretion ceremony *(upanayana)*. The instruction is not to be imparted on pretty numerous holidays and on unlucky natural events and occasions of impurity etc. He has to show particular respect and strict obedience to the teacher. These and similar directions remind us of the statements of *Dharmaśāstra* about the conduct of the Brahmacārin[2] and are copied from them (Car. iii. 8.1-5; Su. i. 2; AS. i. 2.)

It is also not immaterial as to which text-book *(śāstra)* the pupil chooses, since many text-books are current among the physicians. Only such text-book is suited for study as is tested, recognised, easily understood, properly arranged and complete (Car. iii.8.3). The study consists of learning by heart when the pupil reads the sūtras serially, utters them loudly and often repeats them(Car.iii.8.6). It is, however, not sufficient simply to learn them by heart. The teacher should explain every word of the text and the pupil should repeat the explanations. Memory without knowledge would be useless, just like a donkey carrying sandalwood; it only feels the load, without being delighted by its fragrance (Su. i. 4.3-4). Along with learning and teaching

1. cf. Roth, *Indische Medicin : Caraka*, ZDMG, 26, 441-52; Puschmann, *Geschichte des medicinischen Unterrichts* (Leipzig, 1889), 6-15.
2. cf. Hillebrandt, Grundr, 3, 2, Sec. 24-35.

Caraka also speaks of discussions with specialists in different branches. They consist partly of peaceful conversations and partly of disputations, and advance the knowledge, insight, elocution and reputation. Suśruta stresses the necessity of practical training, for even a very learned physician would be incapable of practice without practical training. At the same time, on account of his surgical point of view, he emphasises methodical instruction in surgical operations. So one should demonstrate to the pupil the process of deep cuts, sections and cross-sections on various kinds of gourds and cucumbers, watermelons, superficial parts of filled leather-bags, bladders (of animals) and pockets, the process of curetting on stretched and hairy animal-hides, the process of opening on the blood-vessels of dead animals, or a lotus-stalk, the process of probing on openings of a worm-eaten wood, bamboo, reed, objects like reed in general or dried large bottle-like gourds, the process of removing on the flesh of certain fruits or on the teeth of dead animals, the process of squeezing on a board smeared with wax, the process of suturing on the end of two pieces of thick linen or soft leather, the process of bandaging on the limbs of a doll made of stuff or other material, the process of cauterizing and branding on tender flesh etc. (Su. i.9).

POSITION AND PRACTICE OF PHYSICIANS

After termination of his studies and his practical training, the future physician should secure permission of the king for the practice of medical profession (Su. i. 10.3). This permission of the king is necessary because otherwise the quacks would force their existence in his kingdom and might prove a public calamity (Ḍallaṇa). Caraka speaks very strongly of such cheats who wander about in the streets boasting in the garb of physicians. As soon as they hear of a patient, they hurry and praise loudly their medical capacities so that they reach his ears. They try to win over the friends of the patient by all sorts of attention and emphasize that they would be satisfied

with small remunerations. When they treat a patient and are not able to allay his pains, they assert that the patient does not get the necessary remedies, he disobeys the directions given and that he cannot control his desire. When the case is hopeless they run away. They try to praise their cleverness before uneducated people, and by doing so they only betray their ignorance. They avoid the assemblies of educated people, just as a traveller avoids a dangerous forest. Nobody knows their teacher, pupil or fellow-pupil (Car. i. 29.9).[3] Such quacks are particularly responsible for the bad reputation of physicians, as a result of which it was laid down in Dharmaśāstra not to accept charity from a physician *(cikitsaka)*.[4] Yet the Ambaṣṭhas whose business is healing art, hold a tolerably high position in the succession of castes, because paternally they are descended from Brāhmans.[5] Even the modern Vaidyas in Bengal, of whom about one third practise medicine even to the present day, enjoy high regard. In the middle age the famous Sena dynasty descended from them.[6] The highest aim for a physician seems to be to treat a king and become the physician of the king. It was the duty of such court-physicians to protect the king from poisoning and to inspect the royal cooking for this purpose. This also explains why Cakradatta, the famous medical author, was the son of the headcook of a Bengali king.[7] In war also the physician should protect the king, particularly from poisoning, should purify the wells, food etc. poisoned by the enemy and should stay closely by the side of the king, treat poisonings, wounds and diseases occurring in his army (Su. 1.34). In fact, Alexander the Great gathered the most expert Indian physicians in his pavilion in order to cure serpent-bites and also other ailments (Arrian, *Ind.*, p. 15). Jīvaka Komārabhacca, a contemporary of Buddha, received very

3. cf. Roth, l.c. 452; Avinash Chandra Kaviratna's trans. pp. 408ff.
4. Manu 4. 212; Viṣṇu 51.10. 5. Manu 10. 8, 47.
6. cf. Risley, *The tribes and castes of Bengal* (Calcutta, 1892), 1. 47.
7. ZDMG, 52, 379.

high honorarium for his wonderful cures.[8] A physician mentioned in the *Ṛgveda* desires to receive "horses, cattle and clothing" by means of his healing herbs.[9] The physician should give his medicines gratis to a Brāhman, spiritual teacher, poor, friend, an ascetic and the like. On the contrary, he should not treat the hunters, fowlers, outcastes and sinners. By such procedure he obtains friends, fame, merit, wealth and satisfaction (Su. 1.2.8). Regarding the outward appearance of the physician, Su. 1.10.3 says he should keep his nails and hair short, should bathe and wear a white dress, should wear an umbrella, a stick and shoes. He should be modestly dressed, of friendly speech, accompanied by a dependable servant and should thus go for practice. According to Car. 1.8.18-28 he should direct his attention towards the curing of the patient and should not cause an injury to him even though his own life were at stake, should not think even once of the wife or property of anybody. He should avoid drunkenness, sin and bad company. He should not disclose events in the home of the patient, he should also not utter a word even if he felt the vicinity of death, lest it might do harm to the patient or to others. According to Su. 1.25.44 the physician should treat the patient as his own son.

DIAGNOSIS

The physician should go to the house of the patient at favourable signs, enter the house and observe, palpate and question him (Su. 1.10.4; AHr. 1.1.21). All five senses must be set to work at the medical examination. Thus in an abscess he should feel with the ear the bustling overflow of the air with frothy blood, the sounds in the entrails, the crack of the joint, changes in the voice etc.; with the eye the decrease and increase of body, colour, form and extent of the same, vitality etc.; with the taste the various tastes of urine in diabetes and other ailments, the bad taste in the body by the creeping of lice on the same, and the sweet taste by the creeping of ants etc.; with the

8. SBE, 17, pp. 173ff.; Puschmann l.c. 14.

9. RV, 10.97.; Roth, ZDMG, 25, 646; Zimmer, *Altindisches Leben*, p. 398.

touch, cold or heat, smoothness or roughness, softness or hardness and other qualities of skin in fever, jaundice and other diseases; with the smell, the smell coming out of the body especially at the approach of death. By questioning the patient one knows his native place (or home), his condition, caste, mode of living and diet, the origin of his disease, pains, vitality, appetite, the appearance or non-appearance of flatus, urine or stools, the duration of his disease etc. Much can be decided simply by inference *(anumāna)* (Su. i. 10.5f.; Car. iii.4).

Later works contain particulars of the medical examination. Thus according to Bhāv. i. 2.162f. the eyes are to be examined for their colour (red, yellow, white, brown etc.), further whether lustreless, sunken, watery etc., in order to know as to which of the three *doṣa*-s is affected. Similarly a rough and cracked tongue shows the derangement of wind *(vāyu)*, a red or blackish the derangement of bile *(pitta)*, a covered, moisty and white tongue shows the derangement of phlegm *(kapha)*. The urine becomes whitish by vāyu, red and blue by pitta, only red by blood, white and frothy by kapha. The pulse-examination *(nāḍī-parīkṣā)* is fully described. On this subject there exist special works under the title Nāḍīparīkṣā, Nāḍīprakāśa, Nāḍīvijñāna and the like. According to one [10] of these works, the pulse of left side in the case of women and that of right side in the case of men is to be examined, as a rule, only on the wrist; yet the pulse also in foot, neck and nose is at times examined. The physician feels the pulse by pressing the three middle fingers of his right hand. By vāyu the pulse goes like a serpent or a leech, by pitta it goes like a crow, quail or a frog, by kapha it goes like a swan, peacock, pigeons of different kinds or a cock. The condition is affected by the three Doṣa-s and is incurable if the pulse is sometimes slow, sometimes weak and sometimes exciting, sometimes stopped, sometimes completely lost or scarcely felt, continuously abandons its natural place and then appears again. In diarrhoea the pulse is cool and slow. In cholera it is sometimes not traceable, sometimes it remains

10. *Naḍī-vijñāna* or "An Exposition of the Pulse" by Kaviraja Dhurmo Dass Sen Gupta, Calcutta, 1893.

in its place. In disease of the worms (in intestines) the pulse is slow and weak, many times irregular or weak. In jaundice it is faint or excited as if it would spring out. In hemorrhage it is weak, stiff and soft. In consumption it shows the most varied movements. In internal wounds of the chest the pulse springs high and is quick, in consumption it is quite feeble, in cough it is shaky etc. Even at present the kavirāja in Bengal considers the pulse-examination as particularly important and capability to decide the nature of an ailment from the pulse is attributed to many physicians.[11] The pulse-feeling perhaps originated among the Arabians or Persians.

PROGNOSIS

More particular value is attached to the prognosis, for the clever physician should not treat an incurable patient. Therefore, in the description of diseases the unfavourable symptoms and signs of death are usually enumerated, and the bad omens as well as favourable signs are also discussed.

First of all is considered the messenger *(dūta)* who is sent for the physician, his appearance, caste, clothing, speech, as well as the appearance and behaviour of the physician when he is called. Thus it is unfavourable if the messenger belongs to a caste higher than that of the patient, if he is an eunuch, or a woman or is himself ill, sad, frightful, frightened, or comes running, or holds a weapon or a stick in hand, wears a garment which is worn out or torn or unclean or wet or wears only a single garment, if he is clean shaven or rides on an ass, camel or buffalo etc. Ominous is also the arriving of the messenger at a certain time, like midnight, midday, twilight, moon-eclipse etc., further if he meets on the way certain animals or birds or a corpse, a blind man or an enemy, if he had to face a hot and storng-smeling head-wind etc. The messenger must also not come to the physician when he is sleeping, lies undressed on the ground, is anointed, bears loose hair, perspires or offers

11. Risley, *The tribes and castes of Bengal*, 1.364.

sacrifice to gods or fathers etc. It is, on the other hand, favourable if the messenger is white-clothed, clean, with delightful appearance, is of the caste of the patient, sits in a cart pulled by oxen etc. (Su. i. 29; AS., iii. 12; AHr., ii. 6).

The consideration of omens is extended also to the time of departure and arrival of the physician, and his reaching the patient. The dreams of the patient are also important. Thus one who dreams that he has drunk liquor in company with dead spirits and is attacked by a hound, will soon die of fever. It is also a bad omen if he dreams that a black woman with red clothes laughs at him and dances and binds him with torn hair, and moves to the southern direction, or that dead spirits and mendicants embrace him, or that he drinks honey or oil or falls in a swamp, or being naked, carries a red wreath on his head, or that he is devoured by a fish, or tumbles down from a mountain peak or is carried away by a current etc. (l.c.).

Other Ariṣṭa-s (bad omens) depend upon abnormal changes in the physical or mental condition of the patient. Thus if he feels to be hearing a noise or confounds various noises with each other, if he gets irritated at the voice of a friend and rejoices at the voice of an enemy, feels the cold as hot and hot as cold, feels burning heat in chilblain, does not feel a blow or even the cutting of a limb, believes to have seen stars and moon by day and the sun at night, if his eyes are remarkably restless or motionless, if brown, red, blue or yellow shadows follow him, if his teeth have become brown or have suddenly fallen out, if the tongue is white or brown, dry, heavy, benumbed, covered or rough, the mouth smells badly, the limbs become suddenly heavy or remarkably light, if the veins stand pre-eminent on the forehead not present previously, the sneezing, cough etc. sound differently from the usual, strong perspiration occurs without occasion, the patient does not have any sleep or sleeps continuously, his feet and hands are cold, the breathing is difficult etc. (Car. v. 1. ff; Su. i. 30-32; AS. iii. 9.f.; AHr. iii. 5). The Ariṣṭa-s are not the same in all cases; they change according to the nature of disease. Thus the fever proves fatal if it is severe, deep-seated and continuous, is accompanied by deli-

rium, giddiness, difficult breathing, swelling and indigestion, if the patient is strong but can speak only with difficulty, has red eyes and pain in the chest, is vexed by dry cough in the forenoon or afternoon, if he has lost his strength and flesh, and has phlegmatic cough (AS, AHr), further if he has become senseless and falls down unconscious, if he shivers with cold while he feels hot within, rolls the eyes etc. (Su.). Consumption is fatal if there is pain in the sides, constipation, vomiting of blood and pain in the shoulders. Diabetes is fatal if the usual complications are present, if the urine-secretion is excessive and dangerous ulcers are caused. Hemorrhoids lead to death if the hands, feet, navel, buttocks testicles and the mouth are swollen, there is pain in the chest, sides and limbs, the anus is inflamed, the secretion of blood is excessive and there is thirst, loss of appetite, colic and fever. The stone brings quick death if the testicles are swollen, the urine is retained and there is acute pain (Car. v. 9; Su i. 33; AS, iii. 11; AHr. iii. 5).

Before commencing the treatment *(karman, kriyā)* of a patient, the physician must find out his vitality which is known from certain signs on the body, such as large dimensions of hands, feet, sides, back, nipples, teeth, face, shoulders, forehead etc. He should treat such patients (Su. i. 35).

HEALING SUBSTANCES

Physical ailments, says Caraka i. 1.58, are cured by medicine *(auṣadha)*. Already in the Vedic medicine, the healing plants play a great role along with magic incantations. In the *Bower MS* very many medicaments, mostly vegetables, are mentioned. According to Viṣṇu 92. 17 it is meritorious to give free medicine. By the hospital for men and animals *(cikitsā, ārogya-śālā)* which are mentioned in Aśoka's inscriptions and Purāṇas and elsewhere, one understands by analogy to the modern *davākhānās*, institutions for distribution of medicinal remedies.[12]

According to AS, i. 12 medicines are of two kinds: (1) those

12. cf. Bühler, ZDMG, 37, 98ff: Hemadri, 1.894ff., Puschmann l.c. 14f.

giving strength and (2) those removing disease. The former are elixirs *(rasāyana)* and aphrodisiacs *(vājīkaraṇa)*; the latter appease the disease or prevent its recurrence, and consist partly of mineral, vegetable and animal stuffs, partly of fastings, smearings, incantations and other procedures. According to Caraka, there are animal, vegetable and mineral medicinal stuffs. Of the animal stuffs he mentions honey, milk, excretas, fat, marrow, flesh, faeces, urine, skin, sperm, bones, sinews, horns, claws, hair and the gallstone of the cattle; of the minerals he mentions gold, the five metals (silver, copper, lead, zinc and iron), sand, lime, realgar, jewels, salt, red ochre and antimony. The plants are divided into four kinds : trees bearing fruit, trees having blossom and bearing fruit, plants living for one year and creepers and bushes *(vīrudh)*. Their roots, bark, solid interior, gum, stalk, juice, twigs, potash, milk, fruit, blossom, ash, oil, thorns, leaves, bud-covers, clods and shoots are used. Further Caraka specifies 16 plants among medicinal stuffs the roots of which are used, 19 the fruits of which are used, 3 the juice of which is used and 3 the bark of which is used; four kinds of fat *(sneha)* namely ghee, oil, fat and marrow; five kinds of salt namely *sauvarcala*—a blackish salt being the precipitate of a solution of the usual salt in a solution of rocksalt, *saindhava*—rock-salt from the Indus region, *viḍa*—black salt, a decoction of usual salt with an addition of myrobalans and Soda[13], *sāmudra*—sea-salt, *audbhida*—desert salt; eight kinds of urine, namely of sheep, goat, cow, buffalo, elephant, camel, horse and ass; eight kinds of milk, namely of sheep, goat, cow, buffalo, camel, elephant, horse and woman.

According to Su. i. 37 one must examine the ground while collecting the medical plants, whether it contains holes, pyrites, stones, anthills, desert salt etc., whether it is soft, black, white or red etc. According to the condition the ground has the qualities of the five elements; thus one should take, e.g. purgative from the ground in which earth and water prevail, emetic from the ground in which fire, air and wind prevail. One

13. Watt. *Economic Products of India*, 6, 2. 415.

should learn to know the medicinal plants from cowherds, ascetics, hunters and other people living in forests. One should take the animal substances like blood, hair, nails, milk, urine and faeces from grown-up animals after their digestion. The hut *(bheṣajāgāra)* for preserving the plants should be erected on a clean place. Further (i. 38) he mentions over 700 plants divided into 37 Gaṇa-s according to the diseases for which they are to be applied, and gives them names according to the first plant of every group, as *e g.*, *arkādigaṇa* from Arka *(Calotropis gigantea)*. This classification is crossed by another grouping (i. 39) according to the effect of the medicine as emetic, purgative, errhine or pacifying remedy. Car. i. 1-4 divides the remedies from similar points of view; particularly he mentions in i. 4 fifty groups of decoctions *(kaṣāya)* namely those which prolong life, make the body fat, make it thin, cause secretions, contract (the fractures), raise appetite, give strength, improve the complexion, cure hoarseness, stimulate the voice, remove oversaturation, hemorrhoids, skin-diseases, itch, maggots and poisoning, beget mother's milk or purify it, create or purify the sperm, are remedies for fattening, perspiring, vomiting and purgation, remedy for ordinary and for oily enemeta, errhine remedy, remedy for retching, thirst, hiccup, diarrhoea, for change of colour of the faeces, for increasing the urine and for changing its colour, remedy for cough, asthma, tumour, fever, fatigue, feeling of heat or cold, nettle-rash, arthritis, colic, bleeding, pain, unconsciousness, barrenness and decrepitness. Each of these 50 groups covers 10 plants, so that 500 vegetable medicines are mentioned in them. The most exhaustive collections of medicines inclusive of the eatables and drinks with the exact information of their qualities and effects are contained in the medical glossaries.

PROPERTIES OF MEDICINES

A number of general qualities and effects are attributed to the medicines as well as to the articles along with their specific effects in individual diseases. The six kinds of *rasa*—taste, are

of special importance. They are : sweet, sour, salt, pungent, bitter and astringent. 1. The sweet causes stickiness in the mouth, increases the phlegm, chyle, blood, flesh etc., appeases thirst and hunger, delights and pleases, and causes many ailments like cough, asthma, flatulence, maggots, goiter, elephantiasis etc. when taken excessively. 2. The sour causes sensitiveness of the teeth, salivation and appetite, helps digestion, is mostly agreeable, but causes pus formation in wounds and ulcers and on account of the heat-producing nature of sour substances causes burning in throat, chest and heart if used in excess. 3. The salt purifies and stimulates digestion, but causes itch, tumour and other ailments if taken in excess. 4. The pungent provokes appetite and digestion, lessens the corpulence but its excessive use leads to nervous pain in hands and feet etc. 5. The bitter acts favourably on appetite and digestion, but causes convulsions, headache and the like by excessive use. 6. The astringent cures and purifies woulds, but causes convulsions, cramps and the like by excessive use. All important medicines and articles of food are put by Su. i. 42 in one of these six groups. In medical glossaries also the taste of every stuff is given.

When the stuffs come in contact with the digestion-fire in the stomach, they are changed by digestion *(vipāka)* whereby sweet and salt things became sweet, sour things become more sour, and pungent, bitter and astringent things become pungent (AS, i. 1 ; AHr., i. 9). Many controversies still exist on this subject; the taste may indeed generally be considered as a product of digestion (Su. i. 40).

Every medicine further possesses its own power *(vīrya)* : hot or cold. This is the usual doctrine, yet Su. l.c. mentions a different theory according to which there are eight kinds of *vīrya* : hot, cold, oily or softening, dry or desicative, clear or purifying, slippery, mild and pungent.

All the stuffs have the properties *(guṇa)* of the elements of which they are composed. Thus the purgatives have promi-

nently the properties of earth and water; they are, therefore, heavy and move downwards (Su. i. 41).

CURING METHODS

The most important curing methods are collected together under the name *pañcakarman*, namely vomiting *(vamana)*, purgative *(virecana)*, enemeta *(basti)*, oily enemeta *(sneha)* and nasal therapy *(nasya)*. The most usual vomiting remedy *(vamana)* is *Madana (Randia dumetorum)*, a small sweet fruit like a small apple.[14] As a support to the action of vomiting, the patient puts a castor-stalk in his throat, while an attendant holds him by his head and sides. The physician must examine the vomit. Emetic is indicated in phlegmatic diseases, poisoning, fever, consumption, diseases of female breast, diarrhoea, diabetes, flatulence, cholera, indigestion, dyspepsia, nausea, erysipelas, leprosy, asthma, cough, elephantiasis, heart-disease, excessive fatness, madness, epilepsy, rheumatism, ozena, swollen tonsils and other diseases. Among the *virecana*-s the foremost are *trivṛt (Ipomea Turpetum)*, the most popular remedy of this kind among the Hindus even to the present day, and *eraṇḍa-taila* among the oils.[15] Purgative is prescribed in fever, poisoning, loss of appetite, hemorrhoids, swelling of the body and of the spleen, abscess, leprosy, fistula of the anus, female diseases, erysipelas, cholera, wind-dropsy, diabetes, strangury, wounds, burns, opthalmia, cataract or glaucoma, heat in the head and other parts of body, hemorrhage, jaundice, colic and other diseases (Car., i. 15f.; Su., iv. 33f.; AS. i. 27; AHr. i. 18; Vr. 73f.). An enemeta is called *basti, bastikarman.* The enema-pot should be made of the bladder of cattle, buffalo, boar, goat or sheep or eventually of leather or of thin but closely woven cloth; the tube *(netra)* should be made of gold, silver, copper, iron, brass, ivory, horn, reed etc., ending to a point like cow's tail, 12 fingers long for a patient of 25 years and thick as a thumb at the beginning. Bastis are prescribed in fever, diarrhoea, glau-

14. Dutt, *Materia Medica*, 177.
15. l.c. 202, 231.

coma, cataract, headache, opthalmia, convulsions, hemiplegia, flatulence, calculi (*śarkarā*), colic, swelling of testicles, constipation, strangury, stone, dystocia and many other diseases. They make an impotent potent, a thin man fat, a fat man thin, remove wrinkles and grey hair. Distinction is made between a cleaning enemeta *(nirūha, nairūhika)* and oily enemeta *(snaihika, anuvāsana)*. Oily enemeta should be resorted to when the passages in the body are purified by *nirūha*. The recipes for enemeta are of many kinds. Accidents *(vyāpad)* in enemeta appear to have frequently occurred, since Suśruta counts 76 of them. In the first place he mentions wounds and pains in the anus. Injections in the urinary passages, also in vagina in the case of women, are called *uttarabasti* (Car., viii. 10-12, Su., iv. 35-38; AS. i. 28; 5.4-6; AHr., i. 19, 5.4.f.; Vr., 15f.). Snuffs or nasal remedies *(nasya)* are then mentioned, whereby a medicine or an oil mixed with medicine is put into the nose *(nāsikā*, Su., iv. 40). Like enemeta, the Nasyas are divided into two classes, namely the purifying, purging the head *(śirovirecana)* and oily or strength giving *(snehana, bṛmhana)*. Further the dropping of pungent juice is called *avapīḍā*, the introduction of powder in the nostrils through a reed is called *pradhamana*, the pulling up of oils in the nose by drops without swallowing them down is called *pratimarṣa*. The nose remedies are suited particularly for diseases of head and throat (Su., iv. 40; AS, i. 29; AHr., i. 20; Vr., 78).

In the application of *pañcakarman*, *sneha* and *sveda* precede and they play a great role. Among the animal fats, ghee is the best and among vegetable fats, sesame oil is the best. One can eat the fat or oil either unmixed or with various additions like salt, flesh-broth, flesh, milk, whey, pap and others, or turn them into embrocations, plasters, enemeta, eye-ointments, spraying in the nose and ears and the like. In internal use, the full dose *(uttamā mātrā)* is to be taken by strong patients with good digestion and in swelling of the body, serpent-bite, erysipelas, madness, strangury, constipation; the medium dose in tumour, small blister, itch, leprosy and other skin-diseases, and by those who eat moderately and who are not very strong and

are not constipated; small dose is to be taken by the aged or the children or by persons who are infirm or who have already taken a purgative or have weak digestion or are suffering for a long time from fever, diarrhoea or cough. Car., i. 14 distinguishes 13 kinds of *sveda*: 1. *saṅkarasveda*, fomenting with objects like cowdung, sand etc. made hot in cloth and placing them on the suffering part of the body. 2. *prastarasveda*, sweating by a bed of straw on which the objects are put loosely in a cloth. 3. *nāḍīsveda*, the steam-bath through a reed, one end of which is applied to the body while the other sticks to the boiling pot. 4. *pariṣeka*, bathing with warmed medicinal stuffs. 5. *avagāha*, bath in a cask with warm water and medicines. 6. *jentākasveda*, sweating in a sweating room which is made hot through an oven with many holes. 7. *aśmaghanasveda*, sweating by lying on a hot stone. 8. *karṣūsveda*, filling a ditch beneath the bed of the patient with fire. 9. *kuṭīsveda*, sweating by lying on a bed in a compact hut. 10. *bhūsveda*, lying on level ground, in other respects like 7. 11. *kumbhīsveda*, burying a pot filled with medicines below the bed of the patient and adding heated iron balls or pieces of stone. 12 *kūpasveda*, filling a wide ditch with dung which is kindled and on which the bed of the patient is placed when there is no smoke. 13. *holākasveda*, the bed is placed on a heap of burnt dung.

Sveda is prescribed for rheum, cough, hiccup, asthma, pain in ears, throat and head, hoarseness, pain in the neck, apoplexy, constipation, urinary troubles and many other diseases (Car., i.13f.; Su, iv. 31f.; AS, i. 25f.; AHr., i. 16f.; Vr., 71f.)

By *dhūma* or *dhūmapāna*, fumigations in the nose or mouth are to be understood. According to Caraka the medicines to be used are powdered and kneaded into a ball which is fixed to the end of a reed-stalk. When the ball is dry, the stalk is pulled out, the tube thus formed is put in a pipe of metal, wood or ivory; it is then kindled and the other end of the reed is put into the nose or mouth. According to Suśruta, there are five kinds of *dhūma*. AHr. prescribes *dhūma* for headache and throatache and such other diseases; according to Car., Su., AS. it is prescribed also for sleeping sickness, exhaustion, green

sickness, poisoning, bleeding, mania, etc. (Car., i.5.24f.; Su., iv.40: AS. i.30; AHr., i.21; Vr., 77). Local application of smoke through pipe in ulcers, skin diseases etc. is called *dhūpana.*

Fluids for *kavalagrāha* and *gaṇḍūṣadhāraṇa* (mouth-rinsing and gurgling) are prescribed particularly for the diseases of mouth and teeth. The fluid is to be retained in the mouth until tears come out of the eyes and drops begin to fall down from the nose; then a new portion of the fluid is to be taken (Su., iv.40; AS, i.31; AHr., i.22; Vr., 78).

For the ailments of the eye, instilling of drops *(āścyotana)* is prescribed in the first place, since it removes redness, lachrymation, pain, pus-formation and other affections of the eye. The eye-ointment *(añjana)*, particularly made of Antimonium, is frequently spoken of; which is put into the eye with a probe *(śalākā)* (AS, i. 32; AHr., i. 23). Face-applications are called *mukhapralepa*, application is *pralepa* in general, softening poultice is called *pradeha*, suppository is called *varti*, *phalavarti*, ointment is *lepa*, *abhyaṅga*, *anulepana.*[16] Elixirs *(rasāyana)* form an important class of medicines to be taken internally. They are considered as the seventh subject of medicine; and it is said in many recipes that one could obtain a hundred years' life by their use.

FORM AND QUANTITY OF MEDICINE

We can get an idea of the mixtures used by Indian physicians about 1600 years ago through the recipes that are prescribed in the *Bower MS.* Most of these consist of a considerable number of various ingredients and are adorned with sonorous titles like 'Citron pills of Dioskuroi' *(aśvinīmātuluṅgaguṭikā)*, the ambrosia of ghee *(amṛtaprāśam nāma ghṛtam)*, ghee containing ten medicines *(daśāṅgam nāma ghṛtam)*, an oil for removing wrinkles and grey hair *(valī palitanāśanam tailam)* and the like. Many of these names as well as the recipes themselves are repeated in later medical literature.

In the preparation of medicines too, only a little change has

16. cf. l.c. 17ff.
17. cf. Dutt, *Mat. Med.*, 9. 16.

occurred in course of centuries. Mention may be made here of some chief forms[17] all of which are found in the *Bawer MS*: *Ghṛta*, medicinal stuffs are cooked with an addition of water, milk and the like; mostly for internal use. *Taila*, similar decoctions in oil; mostly for internal application. *Kaṣāya, kvātha*, decoction, particularly of 4 to 16 parts of water with one part of medicine; the mixture is boiled until one fourth remains. *Vaṭikā, guṭikā*, pills and balls. *Modaka*, sweet uncooked pills. *Puṭapāka*, roasted vegetable medicines. The stuffs are turned into a ball which is enveloped in leaves, strung together and is covered with a layer of mud, whereupon the whole is roasted, then the shell is broken and the roasted medicine is given either as pill or powder, or its extract as juice with honey. *Cūrṇa*, powder, is pounded in a mortar and is strained through a piece of cloth. *Kalka*, paste of a plant bruised on a stone. *Svarasa*, natural juice which is produced in a mortar by pounding fresh plants. *Leha, lehya, avalehya*, licking substance consisting of thick extracts from plants with addition of sugar. *Yavāgū*, meal-sauce with an addition of medicinal stuff. *Ariṣṭa, āsava*, a fermented drink of honey, syrup and water with various medicinal stuffs. A variety of this is *cūrṇāriṣṭa*, which is mixed with a powder. *Kāñjika*, fermented rice-gruel. *Kāñjikaguḍa, kāñjikalavaṇa*, mixtures with syrup and salt respectively. As for the doses in which particular medicines are mixed and the mixtures are administered, much has been borrowed by the medical works from the recipes of the *Bower MS*. The apothecary weights correspond in general with those mentioned in Smṛtis. The most important small weight is *guñja*—the seed corn of *Abrus precatorius*, corresponding the modern *ratti* of the apothecaries and jewellers. However, there are wide local differences[18] regarding particulars. Children are to be given smaller doses.

MERCURY AND OPIUM

In order to go into the details of the application and history

18. Bower MS, pp. 13, 78, notes; Colebrooke, Essays 2, 528ff: Bühler, remarks on Manu, 8.134; Dutt, l.c.7-9.151; Sachau, *Alberuni's India*, i.162f.

of particular medical substances, a history of Indian botany, minero'ogy, pharmacy and chemistry is required to be written, for which there is want of space here. Reference may be made to the rich material in Watt's *Economic Products of India*, Hoernle's *Bower MS*, Garbe's *Indische Mineralien* and other works. In general, the use of minerals as medicines appears to have increased continually. The mercury *(pārada)* particularly attained the fame of a universal remedy which was used externally, especially for syphilis in later period, as well as internally. As entire class of literature was created on *rasa* in which other metals and minerals such as sulphur, gold etc. are also dealt with. Mercury is therefore, called *rasendra, rasarāja, rasanātha*, the king of metals. In *Rājanighaṇṭū* 33 different names are given to it.[19] Among the ascetics also the use of a mercury-preparation *(rasapāna)* for prolonging life was common, and even the philosophy daveloped (in 14th century A.D, at the latest) a mercury system *(raseśvaradarśana)*.[20] Mercury does not occur in the *Bower MS*; in Su., AS, AHr., it is mentioned as Rasendra, Pārada only in a few places. Whether Caraka knew it, is doubtful.[21] At any rate the purification *(śodhana)* by heating and the consequent immersion in certain fluids and the 'killing' *(māraṇa)* *i.e.* the calcination or powdering of mercury and other metallic processes which make it fit for pharmaceutical application, are not mentioned in these old works.

Watt[22] leaves the question open whether the Indians knew the medicinal effects of mercury before or after the Arabs. Since, however, the calcination of mercury is traced only to Mahommedan epoch, it may be believed that it originated from the Arabic alchemy in which mercury plays such a great role. The Indian physicians also received from the Arabins the opium which began to be cultivated in India since the 16th century A.D, and was formerly being imported from Arabia.[23] The designation of opium as *ahiphena* 'Serpent-foam' is evi-

19. Garbe, *Die indische Mineralien*, 60.
20. Cowell and Gough, *Sarvadarśanasaṃgraha*, 137-44.
21. cf. ZDMG, 54, 263, Dutt. *Materia Medica*, XII, 22ff.
22. *Economic Products of India*, 5, 234.
23. l.c. 6, 24.

dently only a popular etymological transformation of the old *aphena, afim, afin, afuka*; and these expressions go back to one of the Arabic transformations (usually *afyun)* of the Greek *οπιον* and they come only in later works like *Madanavinoda, Rājanighaṇṭū, Śārṅgadhara, Rasendrasārasaṅgraha* and *Yogaratnākara*, while Caraka, Suśruta, AS, AHr. do not know them. A constipating and narcotic effect *(grāhin, mohakṛt)* is attributed to it, wherefore it is particularly prescribed for diarrhoea[24] *(Atisāra, Grahaṇī)*.

SURGICAL OPERATIONS

The major surgery*(śalya)* deals with the extraction of foreign matters from the body the blunt and sharp instruments, cauteries and brandings and Vraṇa (wounds in the widest sense). The surgery of the eye, ear, nose and throat *(śālākya)* covers all ailments of the head, and especially deals with eye-diseases. Each of these two sciences forms one of the eight subjects of medicine *(Āyurveda)* and Suśruta places it at the head of the same. He particularly points out the special importance of Śalya (Su., i. 1. 3ff.). The more important operations like laparatomy, stone, cataract etc. should be described separately. Here, therefore, only certain general observations may be made.

The surgical operations are divided into eight parts : excision, incision, scarification, puncturing, probing, extraction, drainage and suturing. The surgeon must, therefore, keep ready the followihg : blunt and sharp instruments, cauteries and fire, probes *(śalākā)*, a horn (for cupping), leech, a hollow calabash, probe for cauterization, cotton, cloth, thread, leaves, bandage, honey, ghee, fat, milk, oil, refreshing substances, boiled medicines, ointments, paste, fan, cold and hot water and pans. Sympathetic and strong assistants should also stand by his side. The operation should take place on a lucky constellation, accompanied by a religious ceremony and follow-

24. cf. Dutt. *Mat. Med.*, IIIff.

ed by a lengthy prayer by the surgeon. The patient who should have taken only a little food before the operation, is seated in front of the surgeon and is fast bound. In ulcers or wounds the instrument should be introduced with the precaution of avoiding dangerous places *(marman)*, viens, bones and the like, until the pus is visible, and then should be quickly withdrawn. If necessary, counter-incision should be taken. The cut may be obliquc, round or hemispherical according to the part of the body. The patient should not eat anything before the operation of dystocy, ascitis, hemorrhoids, fistula of the anus and mouth-diseases. After the operation the surgeon should refresh him with cold water, should drain out the wound with fingers on all sides, compress it, wash it out with medicines, cleanse it with cloth, should thereupon spread a layer of thick paste of sesame mixed with honey and butter, besmeared and soaked with medicines, upon which again another layer of paste comes, on it a compress, whereupon the whole should be tied fast with a piece of cloth. Fumigations and incantations then follow. After three days the bandage should be renewed. The healing process should not be precipitated so long as the pus is present. The patient must keep diet (Su., i.5). According to AS,i.38; AHr.,i.29 the patient should be given to eat what he wishes and wine to drink before the operation, so that he may not faint and may not feel the knife.

Of the eight above-mentioned operations, the excision is prescribed in fistula of the anus, unripe growths caused by Kapha, dark moles, edges of the wounds, tumours, hemorrhoids and similar growths *(carmakīla)*, foreign matters in the bones or in flesh, hairy moles, fleshy growths (in the palate), swollen tonsils, rotten ulcers on the penis *(śataponaka)*, a red tumour on the palate *(adhruṣa)*, abscesses on penis, flesh-tumour (in vagina ?), tumour on wisdom-tooth. Incisions are suited to deep going abscesses, growths; erysipelas, swelling of testicles, abscess on testicles or axillary cavity, carbuncles created by diabetes, tumour *(sopha)*, diseases of the mammary glands, pustule on penis,

cysts on eyelids, ulcers on the foot, fistula, throat-inflammation *(vṛnda* and *ekavṛnda)*, the ulcer of the penis *(puṣparikā* and *alajī)*, most of the 'minor diseases', tumours *(pupputa)* on palate and teeth, abscess on the tonsils, hard tumour in the throat and septic tumour or tumour originated from fat. The bladder is, on the contrary, to be opened only in stone. The four curable kinds of Rohiṇī (throat inflammation), leucoderma *(kilāsa)*, a tumour on gums originated from fat, growths, abscesses, tumours on tongue, hemorrhoids, circular spots, growth of flesh and increase of flesh should be curetted. The different veins, hydrocele and dropsy are to be punctured and tapped. Fistula, wounds containing foreign matter and irregular wounds should be probed. The three kinds of sand, or gravel, tartar on the teeth, stone, foreign matter, dead foetus and the faeces accumulated in the anus should be extracted. Abscesses with the exception of the most difficult form, lepary skin-diseases *(makākuṣṭha)*, local swellings, abscesses on ear-lap, elephantiasis, blood-poisoning, tumours, erysipelas, teeth-tumours and many other swellings and skin pustules should be drained. Tumours originated from fat should be sutured after they are cut and cleansed, so also wounds and injuries on movable joints. The threads for suturing should consist of flax or hemp and other vegetable fibres or of sinew or hair of the tail of beasts. The needle should be 2 to 3 fingers long according to the part of body, and straight, round or three-edged or curved. The parts sutured together should be covered with cotton or linen; curing powder should be cast upon them and then they should be bandaged (Su. i. 25).

There are 14 bandages in Suśruta. According to AS, AHr. there are 15 kinds of bandages named after their form. On the buttocks *(bandha)*, axillary cavity, sides, upper part of thigh and on the head a tight bandage should be tied; on the arms and legs, face, ears, neck, penis, scrotum, back, sides, belly and the breast a medium tight bandage should be tied, on the eyes and on joints a loose bandage should be tied. Bandages should not be used in the case of lepary skin-diseases, wounds caused by burning, diabetic-carbuncles, wounds caused by cauteriza-

tion or by poison and similar cases (AS, i. 38; AHr. i. 29, cf. Su., i. 18).

SURGICAL INSTRUMENTS

Descriptions of surgical instruments really agreeing in essentials are made only in Su. (i. 7f.), AS (i. 34), AHr. (i. 25f.).[25] Of the two kinds of instruments, namely the blunt *(yantra)* and the sharp ones *(śastra)*, the former are divided into six kinds with 101 instruments in all. According to Su., the hand is the most importaut of all *yantra*-s, for without it no operation can be made.[26] The main function of the yantra is extraction of foreign matter *(śalya)* from the body, yet AS and AHr. assert that yantras also serve to protect healthy limbs in difficult operations with knife, fire cauteries, *e.g.* in diseases like hemorrhoids and fistula; they also assert that Basti, cupping horns, hollow calabash and other implements should be counted as yantras. 1. *Svastika-yantra* 'cross-shaped instrument' (pair of tongs) should, as a rule, be made of iron, 18 fingers long, the ends of the heads like beasts of prey and birds of prey, the arms of the pair held together by a pin the head of which is as big as a lentil and therefore bent where it is to be held. According to Suśruta there are 24 Svastika-yantras, 9 appearing at the end like the heads of lion, tiger, wolf and other beasts of prey and 15 appearing like the heads of crow, heron, vulture, falcon and other birds of prey. AS and AHr. give no definite number. They serve to extract foreign matters from the bones, and really the 9 yantras bearing the heads of beasts of prey extract such foreign matters as are prominent and are easily seizeable. The best pair of tongs applicable to all parts is that of heron's head. 2. *Saṃdaṃśa* (pair of tongs) of two kinds, with or without arms, 16 fingers long, to extract Śalya from the skin, flesh, veins or

25. Illustrations on the basis of Suśruta's descriptions are found in Wise, *Commentary,* p. 168, in the Su-editions of Abinash Chunder Kabiratna and Jib. Vidya. (3rd edn), in Sir Bhagavat Sinhjee's *History of Aryan medical science,* p. 182 etc.
26. cf. P.Jivanram Vaidya, *Forceps used by the Ancients of India*(Bombay,1892).

sinews. AS, AHr. mention two more Saṃdaṃśas: (i) a smaller kind, 6 fingers long, to extract hair in the nose or on the eyelids, irregular flesh on the wounds and the like and (ii) *mucuṇḍī* provided with a ring on the grip which serves to extract remnants of cut-off Pterygium or to remove irregular flesh in deep abscesses. 3. *Tāla*, spoon, 12 fingers long, resembling the mouth of a big fish. These are two kinds: a single spoon and a double spoon. They serve to extract foreign matter from the ears, nose as fistula. 4. *Nāḍīyantra* 'Reeds', 20 kinds, with an aperture on one end or on both the ends, of different length and strength, according to the organ in which it is inserted, serving to extract foreign matters from the canals (*e.g.* from the ear), for diagnosis (*e g.* of diseases of throat), for sucking (*e.g.* poison), for the facilitation of operations (*e.g.* for washing out wounds) or for introducing medicinal stuffs. These reeds are applied in fistula of the anus, hemorrhoids, tumour, ulcer, enemeta, injection in the urinary passage, hydrocele, dropsy, inhalation, stricture of the urinary passage and the anus. The calabashes and horns for cupping also belong to this. AS and AHr. describe some of these Nāḍīyantras in detail, thus a 10 fingers long and 5 fingers broad reed for the examination of a śalya stuck to the throat, a short but thick reed for examining, cauterizing and operating in the case of piles, a 16 fingers long reed for the examination of female genitals etc. 5. *Śalākāyantra* 'instruments of the kind of awl' are 28 in number. Out of these, seven have earthworm-like points for probing, two have ends like an arrowshaft for shaking, two have ends like a serpent-hood for pushing, two have hooklike points for extracting, two have a little bent ends, of the form of a half lentil for extracting śalya from external organs, six have turban-like points surrounded with cotton for wiping off (pus, blood, cauteries etc.), three have spoon-like points for introducing cauterizing material, three have heads like Jambu fruit for cauteries and brandings, one with a point like a half fruit-kernel for extracting or branding a tumour in the nose. There are three more Śalākāyantras for branding and one for introducing eye-ointment and for cleansing the urinary canal. AS and AHr. mention a foetus-hook *garbhaśaṅku*, for

extracting a dead foetus, a hooklike instrument like serpent's hood for extracting stone in the bladder, an instrument with a point like an arrowshaft for extracting bad teeth, an earspoon etc. and six other instruments. The 25 *(anuyantras)* 'secondary yantras,' *i.e.* helping implements are a magnet (for extracting foreign matter), a horse-bridle ring, branch of a tree (for similar purpose), thread, cloth-pieces and bandage, a hammer (for loosening foreign matter), cautery, fire and medicines, the hand and foot-palms, tongue, teeth, nails and the mouth, time, digestion, cheering and the like.

The knives or sharp instruments *(śastra)* which an expert smith should prepare from iron are divided, according to Suś-ruta, into 20 kinds: 1. *maṇḍalāgra*, with rounded point, accor-ding to Ḍallaṇa either round or formed like a razor, 6 fingers long and, according to Suśruta, applicable for scarification and excision in diseases of eyelids. 2. *karapattra*, saw, according to AS, AHr., 10 fingers long and 2 fingers broad, finely teethed, serving to cut the bone. According to Suśruta, 1 and 2 serve for excision and scarification. 3. *vṛddhipattra*, sharp or blunt, according as it is used for a superficial or deep tumour, serving for deep or superficial excision (AS, AHr.). 4. *nakhaśastra*, with straight or crooked blade for extracting thorns and other small foreign matters and for cutting or cleaving the nails (AS, AHr.) 5. *mudrikā*, ring, a small knife for operation of the throat (AS, AHr.). 6. *utpalapattra*, resembling a blooming leaf of blue lotus. 7. *ardhadhāra*, one-edged or *adhyardhadhāra*, one and half-edged (AS, AHr.). According to AS, AHr., 6th has a long and 7th has a short point; according to Suśruta, 3-7 serve for deep and superficial excisions. 8. *sūcī*, needle, for sewing, of 3 kinds, according as it is used for fleshy parts, for bones, joints and the like or for the dangerous places in intestines or anus (AS, AHr.) 9. *kuśapattra*, bearing the from of a Kuśa-blade, according to AS, AHr., two hands long. 10. *āṭīmukha*, 'Āṭī-beak' *i.e.* formed like the beak of *Turdus ginginianus*, also two hands long (AS). 11. *śarārīmukha* 'Heron-beak' according to Ḍallaṇa, kind of scissors, according to AHr., a trocar. 12. *antarmukha*, 'with point in the middle,' according to AS, AHr., sickle-shaped, 1·5 fingers

long, according to Suśruta (Hoernle) a pair of crooked scissors with straight part in the middle. 13. *trikūrcaka*, trocar. 8-13 serve, according to Suśruta, for cleansing abscesses. 14. *kuṭhārikā*, an axe witha half finger broad blade of the from of a cow-teeth. 15. *vrīhimukha*, 'rice-corn-headed,' the blade 1·5 hands long, a pointed instrument for tapping fluid in dropsy, abscess and the like and for bleeding purposes (AS, AHr.). 16. *ārā*, awl, four-cornered but furnished with a round point serving for boring through the ear-lap and for the examination of tumour (AS, AHr.). 17. *vetasapattra*, *i.e.* cane-formed, edged and serving for boring through or puncturing *(vyadhana)*, which, according to Suśruta, is the purpose of 14-17 in general. 18. *baḍiśa*, 'Fish-hook,' with crooked point, for catching swollen tonsils, pterygium and the like (AS, AHr.). 19. *dantaśaṅku* (*dantalekhana*) tooth-picker, four-angled, serves for removing tartar. 20. *eṣaṇī*, 'probe' of two kinds, *viz.* with earthworm-like point for probing of wounds or needle-like and furnished with a caustic thread for tearing fistula. In AS, AHr., there are 26 *śastras* among which, besides the above, there are a pair of scissors *(kartarī)* for cutting sinews, thread, hair and the like, an edged instrument *(śalākā)* of copper with a point like a grain of corn to prick the cataract, a reed-stick *(khaja)* with 8 points for effecting bleeding of the nose etc. According to Suśruta most of the *śastras* are 6 fingers long. The edges should be so sharp that one could cut the hair on body. The vicarious instruments *(anuśastra)* are leech, cautery and fire, glass, rock-crystal, ruby, adular, cutting bark, hair, finger or fresh shoots for probing, the nail for extracting or cutting, and the like.

CAUTERISATION AND BRANDING

The cauteries *(kṣāra)* are the best and most important of all *śastras* and *anuśastras*, because they are applicable in bad wounds or ulcers which cannot be treated by instruments; they provide for a substitute for the operations of deep and superficial cuts, intersections and scarification etc., cause branding, loosen, cleanse, appease the blood and cause cure, remove the

derangement of *tridosas*, are advantageous particularly in excessive fatness, poisoning, haemorrhoids, skin-disese, bleeding and other diseases, and also can be taken internally.[27] External application is advised in skin-diseases of all kinds ,haemorrhoids, fistula of the anus and other fistula, abscesses, mouth-diseases, throat-inflammation etc.; internally they are used in poisons of lingering effect, swelling of the body, derangement of digestion; loss of appetite, calculli, internal abscesses etc. *Kṣāra* is unsuitable in fever, diarrhoea, heart-disease, head-disease, eye-inflammation, pregnancy or menstruation, faint-heartedness, infirmity, childhood, old age etc. It mostly consists of potash. Wood, leaves, roots and fruit of certain trees are burnt, the ash is collected and comparatively larger quantity (according to Suśruta, 6 times) of water and urine of a cow or other animal is added, the whole is sieved two times through a piece of cloth and is boiled for a long time in a big pan while it is stirred with a spoon. When the fluid becomes clear, red, sharp and phlegmatic, it is sieved through a big piece of cloth and is boiled once more along with an addition of boiled lime-stone and so forth. The application of cautery to the skin takes place with a probe *(śalākā)* around which cotton or piece of cloth (AS) is wrapped, while an assistant holds the patient fast. The skin is first to be rubbed and scarified. The cauterizing material should then be allowed to remain on the skin only so long as 100 words or syllables are uttered. The remedy should be considered as having had its effect if the skin has turned black. Sour substances with honey and ghee should then be applied on the place and other ointments should be used for expediting cure (Su., i, 11; AS, i 39; AHr., i. 30)

Branding *(agni, agnikarman)* is still more efficacious than the cauteries in so far as it cures diseases which are not curable by medicines, instruments and cautery, and the diseases cured thereby do not recur. It is particularly prescribed in tumours, fistula, swelling of testicles, elephantiasis, swollen glands, decolourization of skin, bad wounds or ulcers, opthalmia, headache,

27. Even at present abscesses are rather treated with cauteries than opened with lancet. *See* Dutt, *Mat. Med.*, 21.

haemorrhoids and other diseases. Branding can be effected not only with red-hot iron of various forms *(śalākā, sūcī, jāmbavauṣṭha)*, but also with fluids like honey, syrup, oil or wax brought to boiling point with hot cowdung and other hot objects. The physician should brand the patient until the required effect consisting of bustling noise, bad smell and shrivelling up of the skin is attained. Honey and ghee and other ointments and plasters should afterwards be applied (Su., i. 12; AS, i. 40; AHr., i. 30).

BLOOD-LETTING

The mildest way of extracting blood *(śoṇitāvasecana, śoṇitamokṣaṇa)* is the application of leeches *(jalaukas)*. They are, therefore, particularly suited to the princes, rich people, children, old men, infirm, nervous and delicate persons and women. One should avoid the poisonous species the bite of which causes tumour, strong itch, fever, delirium and other bad symptoms, and should use only the 6 non-poisonous species. The leeches should be kept in a big new pot full of mud and water from a pond, and fresh water and food should be given to them every three days and the pot should also be changed often. The skin-portion concerned should be rubbed dry with a powder of earth and dry cowdung and then leeches should be applied, after the body is smeared with mustard poultice (in order to irritate it) and is placed in water. If it does not bite, a drop of milk or blood should be put on the place or a small cut should be made. If the leech does not set itself free due to greediness, honey or powdered salt should be applied to its mouth. In order to make the leech fit for further use, it should be made to throw out the sucked blood. If the blood of the patient has still not become purified, the bitten places should be made to bleed by rubbing with honey and syrup. When (sufficient) blood has flowed out, the wound should be washed with cold water and should be covered with greased cotton. Astringent, sweet and cold pulp-poultices should than be applied. If the bad blood is removed, the tumour becomes soft, there is no

burning, and redness and pain vanish (Su., i. 13; AS, i. 35; AHr. i. 26).

Cupping of blood is similarly a mild form of treatment. A cow-horn is used for this purpose, at the pointed end of which a small piece of cloth is bound; or a hollow calabash is used in which a burning wick is placed. First of all, the skin is cut in many places *(pracchāna)*, then the broad end of the horn is placed on it and the pointed end of the horn is sucked in order to rarefy the air, and then it is covered with cloth. In the case of calabash, the rarefying of air takes place before applying the burning wick (Su., i. 13; AHr., l.c.). Mention is also made of mere scarification *(lekhana, pracchāna)* without the use of sucking instrument, with regard to the diseases to be cured thereby.

Both the scarification and blood-letting *(śirāvyadha)* are effected with sharp instruments and are, therefore, more severe forms of blood-letting. Bad blood causes abscess, swelling of the spleen, fever, diseases of mouth, eye and head and many other diseases; therefore, one should open the veins for letting out the superfluous blood. Blood-letting is unsuitable for those who have undergone one of the five curing remedies or have taken oily substance, have no bad blood, are below 16 years or above 70 years, women who are carrying or are lying in and also for people suffering from asthma and cough, diarrhoea, vomiting, anaemia, oedema all over the body, apoplexy, hemiplegia etc. The lancets, *kuṭhārikā* and *vrīhimukha* are mentioned as the instruments used in blood-letting. Before the operation the patient should be anointed, sauce of meat of wild animals and rice should be given to him to eat and he should be asked to get seated in a soft seat. A servant should put a piece of cloth around his neck from the back side and hold him fast with it, without causing choking. It depends on the place of the ailment as to which veins the surgeon has to open. Thus in the case of ailment of head and eye, veins on the forehead or on the nose and on external eye-angle, in

ear-diseases the veins on the ear, in nasal diseases a vein on the point of the nose, in madness a vein in the chest, on external eye-angle and on the forehead, in deep-seated abscesses those in the sides and between the armpit and nipple should be opened. The lancet is to be inserted quickly, neither too deep nor too superficial, in the middle of the vein without striking a dangerous place *(marman)*. If the blood does not flow in required quantity, the wound-place should be rubbed with a paste of lamp-black, salt and oil mixed with powdered *tagara (tabernaemontana coronaria)* whereupon the blood flows properly. When it has flowed enough, the place should be moistened with lukewarm oil and salt. If the patient faints, he should be brought to senses by cold water and fanning, and the blood-letting should be continued further; in the case of repeated faints it should be resumed one or two days later. The maximum of tapping blood amounts to 1 *prastha* (=16 *pala* or handfuls). After the operation an oily cloth should be laid on the place and tied (AS, AHr.). According to Suśruta, cold should first be applied for blood-stopping, whereby the blood becomes thick and then astringent decoction or ash should be applied for drying the wound, and in worst cases hot iron should be used. Besides, he mentions various powders for rubbing in the case of excessive blood-flow (Su., i. 14; iii. 8; AS, i. 36; AHr., i. 27).

DIET

In the *Bower MS.* i. 51 the principle is laid down that the sensible physician should first of all take into consideration the regulation of digestion always and in all diseases and then turn to the curing of the disease. According to Car., i. 25.31 proper nourishment is the only way to make the patient strong; injurious food is the cause of ailment. Therefore, nourishing methods and substances serving that purpose *(bṛṃhaṇa, tarpaṇa)*, as well as the fasting methods and the remedies for becoming thin *(laṅghana, apatarpaṇa)*, play an important role. But actually all kinds of food, solid or liquid, are enumerated in groups with

information of their medicinal properties and effects, their taste and natural temperature (warm or cold). Eating flesh is not principally forbidden as in religious literature, but in conformity with the viewpoint of Smṛtis and Aśoka's inscriptions only the use of deer and of the sauce of deer *(jāṅgalarasa)* is recommended. Of the birds, those of the *viṣkira* kind (scrapers), viz. qualis, francoline, sparrows, peacocks, wild hens, partridges and the like should be eaten; of fishes, the *rohita (Cyprinus Rohita)*. The flesh of the animals of marshy place *(ānūpa)*, chiefly of buffalo, is also frequently recommended. On the contrary, one should not eat the flesh of pigs, cattle, most of the fishes, at least not regularly *(na śīlayet*, Car., i.5.8). The medical works also do not take a declining view of the use of spirituous drinks *(madya)* which appears in the Smṛtis as a sin punishable by death, and warn only against over-dose or excess. According to Suśruta, all madya-s are sour in taste, excite appetite and digestion, increase pitta and lessen kapha and vāta, purge and purify the bladder, give an exhilerating effect etc. Fermented drinks from grapes, date, syrup, rice, barley and other plant-stuffs are distinguished and particular effects are attributed to each of them. Liquors are counted among medicinal stuffs and narcotic in operations. The most important articles of food are the various corns, particularly rice, of which a great many varieties are mentioned. The most important are the winter-rice *(śāli)*, particularly the red rice *(raktaśāli)* to which is attributed an effect of curing the disease, the '60 days rice' *(ṣāṣṭika)* which becomes ripe in summer in low contries and *vrīhi*, the rice of rainy season. Besides the rice, barley, wheat, beans, peas, lentils, millet and other corns are mentioned. Suśruta denotes the smaller variety as inferior corn *(kudhānya)*. Further groups *(varga)* are formed by fruit, vegetables, turnip-rooted fruit, herbs (ginger, garlic which is already celebrated in the *Bower MS.* etc.), salt, prepared food (rice-sauce, cooked rice, roasted rice, slime, cake, sour food etc.), liquids like water, milk, oil, molasses, buttermilk, ghee, honey, urine (in medicine) the above-mentioned liquor etc. The best water is rainwater which should be collected in autumn and should be used

throughout the year. On the other hand, unhealthy water is that which is infected by leaves or mud, has bad smell or bad taste. The sugarcane is also eaten raw, but especially medical effects are attributed to its pressed juice, boiled or unboiled, to the syrup and the sugar. Of the oils, sesame oil is especially much used as an article of food as well as a medicine (external and internal). Also discussed in some length are salt, milk and urine. Drink after repast *(anupāna)* is also sufficiently discussed. Thus according to Caraka, milk as anupāna works like ambrosia in exhaustion by fasting, walking, speaking etc. Thin people should take liquor after meal to become fat and fat people should take honey and water to become thin. Then are enumerated *viruddha* foods and drinks, *i.e.* those not suited to one-another and therefore causing unfavourable effect if combined, *e.g.* fish with milk. As usual food Car., i.5.9 recommends rice *(ṣāṣṭika* and *śāli)*, *mudga (phaseolus mungo)*, rocksalt, myrobalans, barley, rainwater, butter, venison and honey (Car., i.27; Su., i.20; i.45f.; AS, i.6f.; i.9f.; AHr., i.5f.; Bhāv, i.1.227ff; Rājani). The quantity of food should be adjusted according to the digestive capacity (Car., i.5 etc.). There are only two daily meals; in the morning and in the evening.

HYGIENIC DIRECTIONS

The day-to-day duties *(dinacaryā)* are both a matter of religion as well as of medicine. The statements in the medical works, therefore, often agree[28] literally with the statements in the Smṛtis and Gṛhya sūtras. Getting up before sunrise, the first duty consists of answering nature's call, at which the head is covered. The cleansing is done with water and earth. Then follows the cleansing of teeth with fresh tooth-stick which should be taken from a certain tree possessing astringent, sharp or bitter taste. Precaution must be taken not to hurt the gums. According to Caraka, the teeth should be brushed two times a day. The tongue should then likewise be scraped with a tongue-

28. Viṣṇu 60ff., Manu iv.35ff. cf. *Early medical literature of India* by J. Jolly, Transact. 9th Orient Congress, p. 459.

scraper *(jihvānirlekhana)*. The mouth should be rinsed with cold water and the face should be washed. The eyes are to be treated every day with an ointment *(sauvīrāñjana*—antimony sulphide)[29] which is applied to the inner surface of the eye-lids. Thereby the eyes become beautiful and keen. Besides, every 5 or 8 days (Car.) or 7 days (AS, AHr.) an ointment *rasāñjana*—an extract from *Berberis asiatica* with milk should be used in order to make the eyes shed tears and thereby to relieve them of kapha and to improve the sight. The whole body should be anointed with fragrant oil to remove the bad smell, heaviness and fatigue in the limbs and itch, loss of appetite etc. Daily anointing of head with oil obstructs the falling or gray hair, allays headache and promotes sleep. Oiling the ears protects one from ear-diseases, stiffness of throat, lockjaw, difficulty in hearing and deafness. Anointing the feet removes roughness, dryness, heat, fatigue, numbness of feet, sciatic pain, fissures of the feet etc. Betel-leaves, camphor, cardamom and other spices should be chewed in mouth in order to promote cleanliness and fragrance of the mouth and appetite. Movement or physical exercise *(vyāyāma)* gives activity, strength, good digestion and reduction of fat. Yet it should be avoided in diseases of vāta and pitta, indigestion and the like. Rubbing or massaging the body *(udvartana)* removes kapha and fat, makes the limbs strong and the skin tight. Bath makes the body clean, promotes appetite, potency and vitality, gives freshness and strength and removes itch, weariness, perspiration, thirst, heat etc. Warm baths or washes are advantageous only to the lower half of the body, but injurious to the upper. Baths are generally harmful in flatulence, rheumatism, indigestion and after meal. To use fragrance and garland, to wear fresh clothes, jewels and ornaments gives potency, good smell, vitality, favouriteness etc. It is likewise advisable to wear shoes, umbrella and a stick. Care of hair, beard and nails is also recommended according to Bhāv., i. 1.93, which also advises to use a looking glass. One must get oneself shaved every five days. Natural

29. Dutt, *Mat. Med.* 73f.

tendencies like stool, urine, sneezing, sleep, phlegm and the like should not be suppressed, nor they be artificially excited. One should not sleep by day except in summer, should not see the rising or setting sun etc. (Car., i. 5; i.4; AS, i. 3; i.5; i.8; AHr., i. 2; i.4; Bhāv., i.1.89 ff.; Vr., 81).

The modifications which the dietetic regulations undergo according to the change of season, are called *ṛtucaryā.* Side by side with the common year, there is, according to Suśruta, a medical year which, like the former, has six seasons *(ṛtu)*, but begins on the 15th February. *Śiśira,* the first season of the common year, is left out, but *prāvṛṣ*, earlier rainy season from 15th June to 15th August, is introduced as a third season. However, time is reckoned usually according to the common year. According to Caraka, one should eat in *hemanta*(15th November to 15th January) fat, sour and salt sauce of flesh of watery and marshy animals and goats and iguana roasted on the spear and the like and beasts and birds of prey *(prasaha)*, because the cold increases the digestive power and enables the digestion of heavy and rich food. He should also take liquor, milk-preparations, sweets, fat, oil, new rice and hot water. Caraka also recommends the use of ointment, massage, anointing the head with oil, residence in hot chamber, in the sun or in a warm underground place or inner room, under the roof of a carriage, in bed and seat with warm cover, warm clothes and smearing the body with a thick paste of aloes wood *(aguru)* as well as sleeping with a fully developed woman. Similar rules are given for *śiśira* (15th January to 15th March); only one should look for a still better and warmer room protected from the wind, and avoid pungent, light, cold and similar food and drink. In both these cold seasons man is at his best strength. In *vasanta* (15th March to 15th May) the accumulated kapha provokes many diseases; therefore, emetics etc., should be taken and heavy, sour, oily and sweet food as well as sleep by day should be avoided. Exercise, massage, inhalations, water-gurgling, ointment, washing and bath in cold water are likwise recommended. As for food and drink, barley and wheat and the flesh of stag, hare, antelope,

quail and francoline, and certain kinds of liquor are recommended. In summer *(grīṣma*—15th May to 15th July) one should eat tasteful, cold, fluid and oily things, cold preparation of barley with milk and sugar, deer, ghee, milk and rice. Spirituous drinks should be taken only in small quantity or not at all or largely mixed with water. Salt, sour, pungent and hot things, as well as physical exercise and cohabitation and sleeping by day in a cool place should be avoided. At night one should sleep in a place which has become cool be rays of the moon, particularly on the windy roof of the house, should anoint oneself with cooling sandal-ointment, get oneself fanned with a cool fan, live in cool forests etc. In the rainy season *(varṣā*—15th July to 15th Sept.) the digestive system is weakened; therefore, one should keep diet, should avoid eating of *udamantha*, sleeping by day, physical exercise, cohabitation, sunheat etc., should eat barley, wheat and old rice with deer and boiled sauce, medicinal liquor in small dose with honey or water which is collected from rain or is previously boiled etc. Massage, baths, residence in dry place etc. are also advised. In summer and in rainy season man is the weakest. In autumn *(śarad*—15th Sept. to 15th Nov.) one should eat in moderate quantity things which are sweet, light, cold, bitter and which lessen pitta, as well as deer, rice, barley and wheat; should use pure water of a spring for washing, drinking, bathing, avoid bitter drink, ghee, purgative, blood-letting, fat and oil, eastern wind etc. (Car., i.6; Su., i.63, vi.64; AS. i.4; AHr., i.3; Vr., 81; Bhāv., i.1.121ff.).

The division of land is threefold according to climatic conditions : *ānūpa*-moist, swampy, *jāṅgala*-dry and *sādhāraṇa*-neither dry nor moist. According to Suśruta *ānūpa* is a watery land with ups and downs, rivers, plenty of rain, thick forest, mild and cooling winds and many high mountains and trees; its inhabitants have a soft, tender and fleshy body, and suffer particularly from diseases of kapha and vāta. *Jāṅgala* is an even land with detached and small thorny trees or bushes, and little rainfall; it draws its water chiefly from wells, has hot and bad winds and has detached and scanty hills; its inhabitants

have a strong but thin body and suffer from diseases of vāta and pitta. According to the law-books, the king should reside in such a place. The commentators of law-books define *jāṅgala* as the land which has little water and grass, is windy and sunny, rich in corn and the like. *Sādhāraṇa* is the land with a combination of both these qualities where cold, rain, heat and wind are proportionate and the three basic principles (tridoṣa-s) are held in balance. The diseases of both the other climates (*e.g.* elephantiasis of the swampy land—Ḍallaṇa) are not so predominant there. The change from one climate into another is unhealthful except when the conditions of the new climate are adjusted by the diet, sleep, work etc. (Su. i.35; AS, i.1; AHr. i.1.; Bhāv., i.1.87f. The parallel passage in Car. iii. 3 in some editions is not genuine).

[Translated from the German by C. G. Kashikar]

CASE FOR A CRITICAL ANALYSIS OF THE CARAKA-SAṂHITĀ

DEBIPRASAD CHATTOPADHYAYA

INTRODUCTORY

The form in which the source-books of Indian medicine reach us is, to say the least, most peculiar. It is the form of a strange amalgam of science and its opposite—or, to be more specific, of natural science and regimented religion. In the present paper, I shall try to make mainly one point. The apparent contradictions in the texts can be explained and it is necessary to do so for the right understanding of the history of science in ancient India. My point is that, in spite of all that is strange in the medical compilations in their extant versions, it is possible to identify the hard core of natural science in these, on which were imposed—evidently later and presumably for the purpose of evading the censorship of the law-makers[1] who insist on abject surrender to the fundamentals of regimented religion—an assorted heap of religious and quasi-religious ideas and attitudes with no scientific significance whatsoever. I shall keep this discussion confined mainly to the *Caraka-saṃhitā*[2], because it provides us with a peculiar advantage for the analysis proposed. We need not go outside this work for determining the

1. I have elsewhere tried to show in detail how for centuries the doctors and surgeons were subjected to continuous condemnation by our legal authorities, because the defence of medicine as natural science required the violation of many theoretical and practical prescriptions considered essential for maintenance of the hierarchical social norm of the law-makers. Accordingly, those through whose hands the medical compilation passed before reaching us in its present form had to concede to the ideological and other requirements of the law-makers for purposes of evading their censorship. D. Chattopadhyaya, *Science and Society in Ancient India*, Calcutta 1977, Chapters 2 & 3.
2. Numerations used for the *Caraka-saṃhitā* refer to its Gulabkunverba edition, Jamnagar 1949.

criterion by which to distinguish what is really intrinsic and what is palpably extrinsic to medical science embodied in the work. In other words, the *Caraka-saṃhitā* gives us not only many examples of the flat contradictions in the text; it shows moreover how to explain the contradictions and avoid the fallacy of taking everything embodied in the text as representing the genuine standpoint of ancient Indian medicine.

FLAT CONTRADICTIONS : THE COW

To begin with, let us note some of the flat contradictions as embodied in the grand medical compilation. The contradictions are both theoretical and practical. We begin with some examples of the latter, because heated controversies are still going on in India about these.

In full conformity with what is generally called Hindu orthodoxy, the text expresses great religious reverence for the cow. But it also shows a frankly medical interest in the animal, prescribing its flesh as diet or drug. In short, it wants people to worship the cow as well as to eat it to meet the purely physical requirements.

Nothing is more pleasing than the former for the orthodox religious sentiment, and therefore also for the law-makers who boost this sentiment for their political purpose. However, though most revolting for the same, the latter also remains embodied in the same text, which, as we shall see, could only be a pointer to the medical conscience of the ancient doctors.

The *Caraka-saṃhitā* enthusiastically recommends the worship of the cow in various contexts.

Describing the codes of right conduct, Ātreya—the spokesman of medicine in our text—is made to declare : "Thus, for example, one should worship the gods, cows, Brahmins, preceptors, elders, adepts and teachers" (i. 8.18). The same discourse understandably prohibits hostility in any form against such holy objects as the Brahmins and cows : "Nothing adverse is to be said against the Brahmins, no stick is to be raised against the cow": *na brāhmaṇān parivadet, na gavāṃ daṇḍa udyacchet* (i. 18.

25). It is indeed madness to think of hurting the cow. Thus the text declares, "Following are the premonitory symptoms of that form of exogenous insanity which is caused by the anger of the gods and others : the proclivity to hurt the gods, cows, Brahmins and ascetics" (ii.7.11). Before attending the lectures on medicine, the student is required to perform certain auspicious acts like offering worship to the gods, sages, cows, Brahmins and others(iii.3.7). The medical student really serious of success, prosperity, fame—and moreover of heaven after death—must have in mind the welfare of all creatures, beginning of course with the holiest of them, namely the cows and Brahmins (iii. 8. 13). If the physician meets on his way to the patient's place certain holy things, he may feel confident that it is indicative of good prognosis; the list of these include the bull and a person of high caste (v. 12. 71). Also indicative of good prognosis is the patient's dream of holy things like the moon, sun, fire, high-caste person, cow, king and others (v.12.18). Before entering the chamber for rejuvenation treatment, the patient must fortify himself by first worshipping the gods and persons of high caste and then by circumambulating gods, cows and Brahmins (vi. 14. 23). Among other remedies for insanity are mentioned the worship of the gods, cows, Brahmins and *guru*-s (vi.9.94). Among the purifying procedures to be observed before collecting the medical herbs is mentioned : "having worshipped the gods, the Aśvins, as well as the cows and Brahmins"—*saṃpūjya devatā aśvinau go-brāhmaṇa ca* (vii. 1. 10).

These are only some examples of a pronouncedly religious interest in the cow that we frequently come across in the *Caraka-saṃhitā*. Judged by these, the work is acceptable to the Brahmins, who—reckless to the possibility of any adverse judgment on their own dignity[3]—propagate the view that the cow is no less holy than themselves.

Strangely, however, the same text also shows a clearly medical interest in the same animal, i.e. an interest in its flesh etc. from the therapeutic point of view. Here are a few examples.

3. It was left for the much maligned materialists or Cārvākas to point to this obvious fact : Śrīharṣa, *Naiṣadhīyacaritam* xvii. 66.

In Chapter 27 of the *Sūtra-sthāna*, the cow is found no longer in the venerable company of the gods and Brahmins, but where it actually belongs according to the general zoological understanding of the text. It is the class of animals called *prasaha* (i. 27. 35-7), i.e. those that grab and tear off their food. To this class belongs 29 varieties of animals—cow, ass, mule, camel, horse, dog, crow, eagle, vulture, etc. The main theme of this chapter is dietetics, from the point of view of which it discusses the food-value of the flesh of all these animals, as also of a large variety of other animals belonging to other classes.

The other classes of animals are : *bhūmiśaya* (i. 27. 37-8) or 'burrowing animals' (pythons, hedgehog, musk, shrew, frog, mongoose, etc.—13 in all), *ānūpa* (i. 27. 39) or 'animals of marshy and wet land' (boar, buffalo, rhinoceros, hog, etc.—9 in all), *vāriśaya* (i. 27. 40-1) or 'aquatic animals' (tortoise, fish, crab, crocodile, etc.—10 in all), *ambucārī* (i. 27. 41-4) or 'aquatic birds' (swan, demoiselle, crane, etc.—29 in all), *jāṅgala* (i. 27. 45-6) or 'herbivorous animals living in grass-lands or forests' (different varieties of deer, etc.—17 in all), *viṣkira* (i. 27. 47-9) or 'birds that scatter their food' (different varieties of quails etc.—19 in all) and *pratuda* (i. 27. 50-3)or 'birds that peck and gobble their food' (30 varieties in all).

We have thus a list of 156 animals classified under eight main heads, called *prasaha* etc. The food-value of the cow's flesh is discussed in this chapter in two forms. First, as the general food-value of the flesh of the general class of animals to which the cow belongs. Secondly, as the specific food-value of the flesh of the specific animal itself, though belonging to a general class.

Thus we are told that the flesh of animals belonging to the five general classes called *prasaha*, *bhūmiśaya*, *ānūpa*, *vāriśaya* and *ambucārī* "are heavy, hot, unctuous, sweet and promotive of strength and plumpness. They are aphrodisiac and highly curative of *vāyu* and great provokers of *kapha* and *pitta*. They are wholesome to the persons who take daily exercise and whose digestive fire is strong"(i. 27. 56-8). The flesh of the cow, as an animal belonging to the *prasaha* class, is therefore viewed as

having certain general food-values which are possessed by other animals belonging to the same class—say, the ass, mule, camel, horse, monkey, vulture, owl, etc.—and also of many other animals belonging to other classes.

But the text is not to be misunderstood. To the five broad classes of animals just mentioned belong ninety varieties of animals. The *Caraka-saṃhitā* is not so naive as to suggest that the flesh of all these animals have the same or identical food-value. What is just referred to simply means that the flesh of all these animals have some very broad properties in common. But the text immediately adds that it is not enough for the physicians' purpose to know only these general qualities :"The general properties of fleshes having been stated, we shall now describe the specific properties of flesh of some of these animals as they have special qualities" (i. 27. 63-4).

What then are the special qualities of the cow's flesh ? The *Caraka-saṃhitā* wants us to accept the following answer : "The flesh of the cow is beneficial for those suffering from the loss of flesh due to disorders caused by an excess of *vāyu*, rhinitis, irregular fever, dry cough, fatigue, and also in cases of excessive appetite resulting from hard manual work" (i. 27. 79-80).

For patients suffering from emaciation due to pectoral lesions is recommended barley-meal with either the milk or meat-soup of the cow, buffalo, horse, elephant and goat (*go-mahiṣī-aśva-nāga-ajaiḥ ksīraiḥ māṃsarasaiḥ tathā*, vi. 1. 183). Some diseases are viewed as due to excess of *vāyū* in the body and since the cow's flesh is considered greatly beneficial in disorders due to excess of *vāyu*, the meat-soup of the cow—like that of various other animals—is recommended as remedies for these ; "The meat-soup of iguana, fox, cat, porcupine, camel, cow, tortoise and pangolin should be *prepared like vegetables* and cooked *śāli*-rice should be given with meat-soup for the relief of *vāyu*" (vi. 14. 126-7).

Since persons suffering from consumption are badly in need of putting on more flesh to their bodies and since the physicians think that the cow's flesh—like that of the other animals belonging to the *prasaha* class—is promotive of flesh and plumpness,

they recommend it for the consumptive patients, along with a number of alternatives to it : "The flesh of the peacock, partridge, cock, swan, hog, camel, ass, cow and buffalo are greatly promotive of flesh", *barhi-tittirī-dākṣānāṃ haṃsānāṃ śūkara-uṣṭrayoḥ-khara-go-mahiṣānāṃ ca māṃsaṃ māṃsakaraṃ param* (vi. 8. 158).

FOOD : RELIGIOUS AND MEDICAL VIEWS

To say all this in the Indian context in risky. There is a strong religious sentiment for the cow and a strong religious taboo against eating beef. The origin of this[4] may form the subject of a serious socio-historical investigation. But the risk faced by the physician is not a matter of controversy. We can easily see this when we take note of the attitude of the law-makers.

For the purpose of ruling the people effectively, the law-makers and politicians of India found a cluster of ethico-religious sentiments extremely useful, which therefore they wanted systematically to enforce. The religious reverence for the cows and Brahmins belongs to this cluster. Here is how P.V. Kane compiles some of the evidences for this : "Manu xi. 79 [? 80] says that if one sacrifices one's life in defence of Brahmin and cows, one becomes free even from the sin of Brahmin-murder. Viṣṇu xvi. 18 declares that even an untouchable went to heaven by giving his life in defence of Brahmins, cows, women and children. In Gautama ix. 13-4, the cow is referred to as *devatā* (god). As early as the second century A.D. we have the collocation of the words *go-brāhmaṇa-hita* (the welfare of the cows and Brahmins) in an inscription of Rudradāman (*Epigraphica Indica*, Vol iii, p. 44). Vide *Gupta Inscriptions* p. 89 for *go-brāhmaṇa-purogābhyaḥ sarva-prajābhyaḥ*. These words also occur frequently in the *Rāmāyaṇa* (Bālakāṇḍa xxvi. 5;

4. R. L. Mitra in *JASB* xli. 174-196 (*Beef in Ancient India*) shows that the taboo was unknown in the ancient (specially Vedic) period. The exact origin of the taboo, however, remains yet to be more intensively investigated.

Araṇya xxiii. 28) and in the *Matsya-purāṇa* civ. 16."[5]

However, notwithstanding the systematic efforts of the law-makers and politicians to boost the veneration for the cow—notwithstanding their declaration that the slaughtering of the cow is a very grave sin (Manu xi.60) removable only by prolonged penance (Manu xi. 109f)—the genuine physicians of ancient India appear to be obliged to take a different view altogether. What interests them is a different point. It is the food-value of the cow's flesh, like that of the flesh of various other animals, because—medically speaking—they feel convinced that the most important factor determining our health is the food we take.

This being a fundamental proposition for the genuine doctors, they have hardly the scope to introduce the religious or any other consideration into their view of food. As it is very plainly said in the *Caraka Saṃhitā* : "Food is all of one kind, eatibility being the common feature. But it is of two kinds as regards its source—one kind being inanimate and the other animate. It is also two-fold in respect of its action, consequent on its being either wholesome or unwholesome in effect. It is four-fold in respect of its taking, namely to drink, suck, eat and lick. It is sixfold in respect of taste, because there are six categories of taste" (i. 25. 36).

In such a dry secular view of food, there is no scope for the intrusion of any religious consideration. The only consideration allowed for the selection of food is its wholesomeness or unwholesomeness. Hence it is declared : "Neither out of greed nor out of ignorance should one resort to dietary. Only after careful investigation should one eat what is wholesome, for the body is verily the product of the food one eats"(i.38.41).

The physician's view of food is summed up again in a recapitulatory verse, which reads : "The body is the product of food, disease is born of food, the distinction between happiness and sorrow results from the difference between the wholesome and unwholesome diet" (i.28.45).

5. P. V. Kane, *History of Dharmaśāstra*, Vol. ii, Poona 1941, p. 775.

MEDICAL ETHICS AND TRADITIONAL MORALITY

If the doctors in our *Caraka-saṃhitā* are convinced of the medical efficacy of all sorts of flesh, let us not forget however that they have to face a formidable problem in prescribing these for the patients. They cannot but be aware of the possible strong disgust in the patient for at least some forms of flesh provoked by the patient's religious, aesthetic and other sentiments. The revulsion for such flesh may be strong enough in the patient to lead him either to stubbornly refuse these or even to vomit these out if forcibly administered. What, then, are the physicians to do ?

Our text answers the question immediately before recommending the flesh of swan, hog, camel, ass, cow, buffalo, etc. already quoted—vi. 8.158, elsewhere (vi. 14.126) saying that such forms of flesh are to be "prepared like vegetables."

What is for us most remarkable about this answer is a simple point. The physician as physician is interested only in one thing, and that is the cure of the patient. If, therefore, it is essential for the patient to eat some flesh, the physician has to work out some tactics to evade the patient's religious or aesthetic revulsion against these. When necessary, such a tactical method may include deliberate deception or sheer bluff. It is thus not any absolute fidelity to traditional morality—inclusive of absolute truthfulness—that makes one a model physician. What makes one so is also the occasional capacity to lie—though of course in the patient's interest.

The entire discussion of this in the *Caraka-saṃhitā* needs to be quoted here, for it has considerable theoretical interest for understanding the position of the real physician in our medical compilation. What concerns him is medicine and medicine alone. If, therefore, there is any direct clash between medicine and morality in its abstract sense, the physician as physician cannot help choosing the former. However, there is no real clash for him between scruple and medicine, because the only scruple that he is aware of is that of curing the patient. Hence the *Caraka-saṃhitā* declares :

"For the emaciated consumptives continuing to lose flesh, the physician skilled in dietetics should prepare well-cooked dishes of meats of carnivorous animals. To the consumptives must be given peacock's flesh and—in the name of peacock's flesh—the flesh of vultures, owls and blue jays properly cooked in prescribed manner. In the name of partridge, give the flesh of crows; in the name of snake-fish, give the flesh of snakes ; in the names of intestines of fish, give fried earth-worms. In the name of rabbit-flesh, the physician may give dressed meats of fox, large mongoose, cat and jackal-cubs. For increasing the flesh in the consumptive patient, the flesh of lion, bear, hyena, tiger and similar carnivorous animals may be given in the name of the flesh of deer. For promoting the flesh of the patient, the meat of the elephant, rhinoceros and horse—well-seasoned with spices—should be given. The flesh of birds and animals that have grown plump on the flesh diet is an excellent flesh-increasing food...*Those fleshes that are considered unpleasant by the patient because he is not used to them should be given to him with deceptive names. Then he readily takes these. But if their real nature be known, these will either be not eaten at all out of revulsion, or even if eaten, will be vomited out. Hence these must be disguised and given under false names*" (vi.8.149-57).

In view of this, we can perhaps better understand why in the Indian medical tradition "cooking" was considered as one of the ten essential techniques, proficiancy in which was required of a practising doctor. (See *Introduction to the Caraka-saṃhitā*, Gulabkunverba edition, Vol. i, pp. 188-9). But let us return to the discussion of medical ethics in our text.

Can a physician—with a medical scruple as strong as to declare the above—be prevented by religious or other considerations to recommend the flesh of the cow in cases where he is convinced of its medical efficacy ? It seems that the genuine physician in the *Caraka-saṃhitā* shows no such inhibition. Immediately after the discourse on the need of occasionally deceiving the patient with false names of the meats served to

him, we read in the text the recommendation of the cow's flesh specially to the consumptive patients, though with the suggestion of various alternatives to it like the flesh of the hog, camel, ass, buffalo, etc.

All this does not mean that the medical compilation shows any special fad for beef-eating, as some of the early social reformers of Bengal wanted deliberately to cultivate as part of their struggle agalnst superstition. Though without any inhibition against it, the text shows no uncritical enthusiasm for it. As far as the ancient doctors understand, beef is not easily digested and *in this sense*, a rather undesirable form of meat, just as wild barley is among grains furnished with awns, black gram among pulses, river water of the rainy season among waters, etc. (i.25.39). Such, then, is the medical view of beef, which has nothing to do with the rel'g'ous taboo against it. When medically necessary, the doctors consider it a must for the patient.

CELIBACY : ALCOHOL AND ALCOHOLISM

What we are trying to show is that the *Caraka-saṃhitā*, in the form in which it reaches us, is found to embody a set of ethico-religious values, which, though decreed by our law-makers, seem to go against the hard-core of medical science embodied in the same text. We shall mention here only another example of such a flat contradiction.

Apparently for the purpose of assuming the form of extreme piety, the text goes to the extent of asserting that those with medical knowledge proper declare celibacy or *brahmacarya* as the best road leading to liberation : *utkṛṣṭatamaṃ...brahmacaryam ayanānām iti* : *evam āyurvedavidaḥ manyante* (i.30.15).

But the question is : Can such a declaration have anything to do with the genuine medical standpoint ? Before answering this, we may have some clarification about celibacy or *brahma-carya* in its actual context of ethico-religious values.

On the authority of Āpastamba (i.1.2.23), Manu (ii.177) and Yājñavalkya (xci.33), P.V. Kane observes that an essential

precondition for the observance of celibacy is to "abstain from every kind of intoxicant."[6] As a matter of fact, the question of celibacy apart, the Indian law-makers express very strong disapproval for alcoholic drink as such. Gautama (ii.25), Āpastamba (i.7.21.8), Vasiṣṭha (i.20), Manu (xi.54), Viṣṇu (xxxv.1) and others declare that drinking alcohol *(surā* or *madya)* is one of the gravest sins or *mahāpātaka*-s.[7]

To the genuine physicians of the *Caraka-saṃhitā*, however, any absolute view of the desirability or otherwise of alcohol seems to be impermissible, because real medical knowledge allows no such absolute view. As the *Caraka-saṃhitā* declares, "Wine is produced from various substances and possesses various qualities. It has various actions on the body. It is intoxicating in nature. Hence it should be understood from the point of view of both its good as well as evil effects. If a person takes it in right manner, in right dose, in right time and along with wholesome food, in keeping with his vitality and with a cheerful mind, to him wine is like ambrosia. While to a person who drinks whatever kind comes in hand to him and whenever he gets an opportunity and whose body is dry on account of constant exertion, this very wine acts as a poison" (vi.24.26-8).

Following this dialectical approach, therefore, they proceed to explain some details of their understanding of alcohol. This discussion of the *Caraka-saṃhitā* seems to retain interest even in our times. We quote it at some length :

"Three stages of intoxication are observed in a person who drinks wine : the first, the middle or the second and the last or the third. We shall describe the characteristics of each of these.

"It promotes exhilaration, delight, a finer discrimination of the qualities of food and drink, desire for music, songs, jokes and stories. It does not impair the intellect or memory and causes no incapacity for sense-pleasures. It promotes sound sleep as well as happy awakening. This is the first or happy stage of alcoholic effects.

"Fitful recollection, fitful forgetfulness, frequently indistinct,

6. *Ibid.* ii. 796. 7. *Ibid.* ii. 795.

thick and larynged speech, indiscriminate talk, unsteady gait, impropriety in sitting, drinking, eating and conversation—these are to be known as the second stage of alcoholic effects.

"After transcending the second stage and before reaching the last stage, there is no impropriety which persons of *rājasika* and *tāmasika* nature will not commit. Which wise man would ever wish to be intoxicated to an extent which is as frightful as insanity, even as no traveller will select a road which leads to an unhappy end and which is beset with many troubles ?

"Having reached the third stage of intoxication, he becomes paralysed like a felled tree with his mind submerged in intoxication and stupor, and though alive resembles a dead man. He does not discriminate or recognise either the qualities of things or of his friends. He does not possess even a sense of his own happiness, for the very sake of which alcohol is drunk. Which wise man would like to attain that state in which he cannot discriminate between what ought to be done and what ought not to be done, between pleasure and pain, and between what is good and what is evil in the world ? On account of his addiction, he is condemned and censured by all people and is regarded as an unworthy man by them, and he later on develops painful diseases as a result of his addiction" (vi. 24. 41-51).

And so on. The *Caraka-saṃhitā* is indeed very keenly aware of the undesirable consequences of excessive drinking. It is aware of alcoholism as a morbid condition, for which are prescribed certain remedies, inclusive of the controlled use of alcohol itself (vi. 24. 113) and—reckless of the ethico-religious norm of celibacy or *brahmacarya*—"the aid of affectionate embraces of female bodies full of warmth of youth, the warm clasp of their waists, thighs and fullgrown breasts" (vi. 24. 134). What nevertheless is remarkable about the text, however, is that it refuses to judge alcohol by the alcoholic behaviour or the intrinsic worth of the drinks by the consequences of morbid drinking. Thus it declares :

"But wine by nature is regarded as similar to food in its effects. It is productive of disease if taken in improper manner and is like ambrosia if taken in the proper manner...Wine,

taken in proper manner, soon gives exhilaration, courage, delight, strength, health, great manliness and joyous intoxication. It is an appetiser, digestive stimulant, cordial promoter of voice and complexion and is nourishing, roborant and strengthening. It relieves fear, grief and fatigue. It acts as a soporific to those suffering from insomnia and as a stimulant of speech in reticent people. It keeps awake people given to excess of sleep and relieves obstruction in the body-passages, renders the mind unconscious and of the pain of trauma, ligature and other kinds of pain and suffering. It acts as a cure for disorders resulting from alcoholism. It increases the enjoyment of sense-pleasures and the desire for the continuance of such pleasures. Even to the very aged, alcohol gives elation and delight. There is nothing comparable on earth to the delight derived during the first stage of alcoholic effects, from the perceptions of the five senses in the case of either the young or the aged. Alcohol, taken in proper way, is a relaxation for all people afflicted with multitude of sufferings and sorrow" (vi. 24. 59-67).

All these, it needs hardly to be added, do not agree with the eulogy of celibacy or *brahmacarya* as the royal road to liberation or *mokṣa*. It is, therefore, impossible to evade the question : Which of the two attitudes embodied in the same text represent the genuine standpoint of the ancient physicians ?

Fortunately, we need not go outside the text to answer the question. In the *Caraka-saṃhitā* itself is embodied the criterion for identifying what is intrinsic and what is extrinsic to medical science.

THE CRITERION

Let us begin with a brief account of a medical colloquium recorded in the text. The main question discussed in it is that of *vāyu* or wind, which, as it is generally known, is viewed in Āyurveda as one of the morbid matters causing various diseases. The first four participants of the colloquium—Kuśa Saṅkṛtyāyana, Kumaraśirā Bharadvāja, the Central Asian

physician Kāṅkāyana and Baḍiśa Dhāmārgava—discuss the question remaining on the whole within the general framework of Indian medicine. Then another participant—called *rājarṣi* Vāryovida or 'Vāryovida, the royal sage'—finds all this inadequate. He expounds some kind of an anthropomorphic view of Wind as the ultimate principle governing everything—a view reminiscent of some trend of metaphysical speculations in the Upaniṣads (*Bṛ Up* i.5.22-3; iii.7.2; *Ch Up* ii.24.9; iii.16.2; iv.3.lf; *Tait Up* i.5.3; i.7; *Mait Up* vi.23; *Kauś Up* ii & iii; etc). After propitiating Vāyu or Wind, he delivers a long discourse on it (i.12.8).

But another medical authority, called Marīci, leaps to the attack : "Even if all these were true, what is the point in saying or knowing these in the medical discipline ? Whatever is said here must be said strictly in accordance with the requirements of medicine"—*yadi api evam etat, kim arthasya asya vacane vijñāne vā sāmarthyam asti bhiṣag-vidyāyām ? bhiṣag.vidyām adhikṛtya iyaṃ kathā pravṛttā iti* (i.12.9).

We have in this bold protest of Marīci against Vāryodiva's metaphysics a clear hint of the criterion by which to judge what is intrinsic and what is extrinsic to medical science in our extant medical compilation. What interests the physician is medicine and medicine alone. Anything without strict relevance for medicine is to be rejected as extrinsic to medical science, irrespective of its truth or otherwise from the non-medical standpoint. Lest the importance of this be undermined as being based on a mere isolated statement of an individual doctor, we shall note here how this point is variously reiterated in the *Caraka-saṃhitā*.

MODEL OF MEDICAL TREATISE

One peculiarity of the *Caraka-saṃhitā* is that it is already aware of considerable differences of opinion among the different medical authorities (iii.5.4; iii.5.13; vi.3.65-66; vi.3.117; vi.3.192; vi.14.6; vi.14.33; etc). It gives us accounts of debates among physicians, in which they sometimes express themselves

strongly against each other. Such debates are moreover considered highly desirable for the enrichment of medical knowledge (iii.8.15). *Caraka-saṃhitā* also mentions theoretical conclusions characteristic of other systems of medicine, i.e. differing from the one supposed to be codified in our text (iii. 8.37). Apparently, in the ancient period, medical science is yet to be tongue-tied by authority, clash of views having much to contribute to its growth.

We are further told : "Among the people are current various treatises on medicine" (iii. 8. 3). Hence, after making up the mind for going in for medical studies, one has first of all to select the right treatise for oneself *(ib)*. The need is thus felt for describing the model medical treatise. That the extant *Caraka-saṃhitā* grossly deviates from this model, is only a sad commentary on the work of its later redactors and editors, among whom Dṛḍhabala, through whose hands the text finally passes before reaching us, frankly confesses that while "reconstructing" the ancient text one creates it anew (*saṃskartā kurute tantraṃ purāṇaṃ ca punaḥ navam* : viii. 12. 37) and for this purpose he collects distinctive propositions from a large number of other treatises*(kṛtvā bahubhyaḥ tantrebhyaḥ viśeṣa-uñcha-śila-uccayam*: viii, 12.39). Notwithstanding this, there is no reason to take a light view of the model itself, for apart from its intrinsic worth, the presumption is that this norm comes down from the ancient authorities themselves, the other alternative being to imagine that the later editors or "reconstructors" of the text themselves set up a model only to flout it rather grossly.

For our present purpose, the most important point to be noted about this model is that a medical treatise must confine itself exclusively to topics having strict relevance for medical science, that it must not contain anything extrinsic to or irrelevant for its subject-matter, or, as the text puts it, it must not mix up *(asaṃkula)* its actual theme with anything else (iii. 8. 3).

TWO FALLACIES

This chapter of the *Caraka-saṃhitā* which formulates the model

of medical treatise, finds it necessary to go also into much detail of the methodology of medical discussion. In the course of this, it explains certain fallacies resulting from the violation of the norm of right discussion. Two of these are specially important for our present discussion. One is called *adhika* or redundance, a form of which is irrelevance. The other is a particular form of the fallacy of contradiction or *viruddha*. Both these fallacies are included in the final list of what is technically called *nigrahasthāna* or "point of defeat" (iii. 8. 65), implying that the fallacy of redundance is no less serious than the fallacy of contradiction. One committing any of these fallacies forfeits one's right to medical discussion.

What, then, are the two fallacies ?

FALLACY OF IRRELEVANCE

The fallacy of irrelevance(*adhika* in one form) is illustrated as follows : "Thus, for example, while discussing medical science, to quote the authority of Bṛhaspati, Uśanas, or to cite anything which is not strictly relevant to the subject-matter of medicine" —*yat vā āyurvede bhāṣyamāne bārhaspatyam auśanasam anyat vā yat kiñcit apratisaṃbaddhārtham ucyate* (iii. 8. 54).

Uśanas—and also Bṛhaspati in this particular context—are supposed to be renowned authorities of political science and jurisprudence in ancient India. But though considered authoritative in their own fields, it is only by committing the fallacy of irrelevance that one can quote them in a medical discussion. The reason for this is simple : medical discussion is supposed to be confined to medicine and medicine alone. A statement, even though authenticated by some otherwise exalted persons, is not to be allowed in medicine unless of course it has a definite medical significance. Let, therefore, Uśanas and Bṛhaspati enjoy their authority in their own fields. Since, however, what they say is irrelevant from the medical viewpoint, a doctor is not allowed to cite their authority in the medical discussion. Such a dictum can be formulated only by those who have very strict fidelity to their own subject. In this we

can thus see the real spirit of the true representatives of ancient Indian medicine.

FALLACY OF CONTRADICTION

The fallacy of contradiction or *viruddha*, as the *Caraka-saṃhitā* wants us to understand it, has three forms, resulting from a statement contradicting any of the following : 1) the instance *(dṛṣṭānta)* cited in favour of it, 2) the conclusion *(siddhānta)* which it intends to establish and 3) the specific context *(samaya)* in which it is made : *viruddham nāma dṛṣṭānta-siddhānta-samayaiḥ viruddham* (iii.8.54). Of these three, we are specially interested here in the last, viz. the fallacy of contradiction resulting from a statement going against its own context or *samaya*. The *Caraka-saṃhitā* wants to be quite specific about it :

samayaḥ punaḥ tridhā bhavati. yathā : āyurvaidika-samayaḥ, yājñika-samayaḥ, mokṣa-śāstrika-samayaḥ ca iti.

tatra āyurvaidika-samayaḥ : catuṣpādam bheṣajam iti.

yājñika-samayaḥ : ālabhyā yajamānaiḥ paśavam iti.

mokṣa-śāstrika-samayaḥ : sarvabhūteṣu ahiṃsā iti.

tatra sva-samaya-viparītam ucyamānaṃ viruddhaṃ bhavati. (iii.8.54)

"Context, again, is threefold. These are : 1) the context of medical science, 2) the context of ritual sacrifice and 3) the context of the doctrine of liberation.

"Among these, the context of medical science. (A statement relevant for it is :) 'Medical science depends on four factors (viz. the physician, substances used as drugs etc., nursing attendant and the patient).

"The context of ritual sacrifice. (A statement relevant for it is :) 'The sacrificial animal is to be slaughtered by the *yajamāna* (one who gets the sacrifice performed).

"The context of the doctrine of liberation. (A statement relevant for it is :) '(One must practise) non-violence to all living being.'

"A statement becomes contradictory when it is made in viola-

tion of its own specific context."

The examples are carefully chosen. It is essential for the sacrificial context to state that the sacrificer must slaughter the sacrificial animal. It is equally essential for the context of the doctrine of liberation to state that one must practise total non-violence. Thus the essential proposition of one context, if allowed to be mentioned in that of another, results in flat contradiction. However, the physician is interested in neither of these two contexts. He is interested only in safeguarding the integrity of his science. For this purpose, he is formulating the general rule that in medical science no proposition is to be allowed which does not belong to the strictly medical context, the detail of which we shall presently discuss.

But let us first note a few points The way in which 'the fallacy of contradiction resulting from the confusion of contexts' is illustrated in the text, has its own interest. It is the way in which the physician is trying to defend the integrity of his science against the possible intrusion of counter-ideology. No proposition belonging to the context of ritual or that of *mokṣa* is to be allowed in medicine. But these two contexts of ritual and liberation represent the two branches of Vedic orthodoxy, generally called its *karma-kāṇḍa* and *jñāna-kāṇḍa*. Sacrificial ritual is the be-all and end-all of the former, liberation that of the latter. To resist the invasion of medical science by Vedic orthodoxy, the physicians require the general rule of excluding the possible confusion of contexts. In substantiation of the rule, they remind the doctors of the two main branches of Vedic orthodoxy and of the fatal consequence of confusing these with medicine. Thus the way in which the physicians illustrate this amounts to the assertion that, for the sake of self-consistency, medical science has to avoid Vedic orthodoxy as a whole. Significantly, apart from the context of strict medical science, the text speaks only of two other contexts —the ritual-context and liberation-context, i.e. *karma-kāṇḍa* and *jñāna-kāṇḍa*. Propositions belonging to either of these two are not to be allowed in medicine.

The physicians seem to reiterate the dictum, in the course of which they find it necessary also to come out with a defence of the essentially rationalist attitude. As it is put in the *Caraka-saṃhitā* :

"In a colloquium (*vāda*, usually meaning 'debate') of the physicians, they must move strictly within the limits of medical science and must not digress to anything else (*vādastu khalu bhiṣajaṃ pravartamānaḥ pravarteta āyurveda eva, na anyatra)*. The propositions and counter-propositions on all the topics covered by it are to be clearly and cogently worked out. Every statement made must be based on a clear and careful understanding of these. Medical discussion is to allow no proposition which is irrelevant, unauthoritative, uninvestigated, without any practical significance *(asādhaka)*, confused and without a general applicability *(avyāpaka)*. Every proposition must be substantiated by reason *(sarvaṃ hetumat brūyāt)*. Only those propositions that are substantiated by reason and are untainted by any other consideration, prove useful for therapeutic purposes, because such propositions alone help the intellect to be broadened *(praśasta-buddhi-vardhakatvāt)* and only uninhibited intellect *(anupahata-buddhi)* leads to the successful culmination of an undertaking" (iii. 8. 67).

SPECIFIC MEDICAL CONTEXT

Before we proceed further to analyse the extant *Caraka-saṃhitā*, we have to be clear about one question : What exactly is the nature of their own specific context—that of the medical science—the integrity of which the physicians want to preserve and therefore the possible confusion of which with anything else they want to avoid ?

This is briefly answered in the passage quoted illustrating the fallacy of contradiction : *catuṣpādaṃ bheṣajam iti*, literally "medicine is four-legged". In other words, there are four and only four factors on which medicine depends. This view of medicine as depending on four factors retains considerable importance in the *Caraka-saṃhitā*. Two chapters of the book

discussing the general principles (Sūtra-sthāna) are designed for the specific purpose of explaining it (i. 9. & i. 10). Let us sum up their main points.

In the Āyurvedic view, successful medical treatment depends on four factors. These are : the physician, substances (drugs or diets), nurse and patient. Accordingly, chapter i. 9 of the *Caraka-saṃhitā* is designed to explain these four factors, or more properly, the desirable qualities or qualifications of each of these four, the combined operation of which leads to therapeutic success. The text mentions in this connection four such qualities of each of these four factors. We quote these not only to show how remarkably free the medical view is from supernaturalism and scriptural cant but moreover because some of the things said by the ancient doctors retain profound significance even for our times.

The four essential qualification of the physician are : 1) clear grasp of the theoretical content of the science, 2) a wide range of experience, 3) practical skill and 4) cleanliness.

śrute paryavadātatvaṃ bahuśo dṛṣṭakarmatā /
dākṣyaṃ śaucam iti jñeyaṃ vaidye guṇa-catuṣṭayam // (i.9.6).

The four essential qualities of the drugs or substances are : 1) abundance, 2) applicability, 3) multiple use (or, what is perhaps called "broad spectrum" in modern medical jargon) and 4) richness in efficacy.

bahutā tatra-yogyatvam anekavidha-kalpanā /
sampat ca iti catuṣkaḥ ayaṃ dravyāṇāṃ guṇa ucyate // (i.9.7).

The four essential qualifications of the nursing attendant are : 1) knowledge of nursing technique, 2) practical skill, 3) attachment for the patient and 4) cleanliness.

upacārajñatā dākṣyam anurāgaḥ ca bhartari /
śaucaṃ ca iti catuṣkaḥ ayaṃ guṇaḥ paricare jane // (i.9.8).

The four essential qualifications of the patient are : 1) good memory, 2) obedience to the instructions (of the doctor), 3) courage and 4) ability to describe the symptoms.

smṛtiḥ nirdeśa-kāritvam abhīrutvam atha api ca /
jñāpakatvaṃ ca rogāṇām āturasya guṇāḥ smṛtāḥ // (i.9.9).

Something is so striking about this enumeration of the

qualities of the "four factors" ensuring medical success that it is impossible for us to overlook it. While enumerating the desirable qualities of the patients, the medical compilation is absolutely silent about the accumulated merits of his past actions contributing to his recovery. In other words, it is totally silent about *karma* and *adṛṣṭa*. How are we to account for this silence ? Could it be that the ancient physicians were unaware of the importance attached to this view in the officially boosted world-outlook of ancient India ? It is obviously impossible to take such a possibility seriously. Could it then be that the doctors believed in *karma* and yet forgot to mention it in this context ? This again is inconceivable, because the discussion of the merits of the patient is about the surest context of mentioning the *adṛṣṭa* of the patient on the part of those who believed in it. The silence of the *Caraka-saṃhitā* about *karma* and *adṛṣṭa* of the patient, even in this context of discussing the qualities essential for his recovery, can thus have only one significance for us. From the medical viewpoint, *karma* is considered a redundant hypothesis. So the physicians prefer to ignore it altogether. They have far more serious things to discuss instead, namely the real merits of the patient really contributing to his recovery. These are good memory, obedience to the doctors, fearlessness and the ability to communicate the exact nature of his troubles.

A doctor today has perhaps little to add to the ancient doctors on the basic desirability of these qualites in the patient. But the situation in which he is placed is quite different. A great deal of political courage is not required today to say all these. But this political courage was required of the ancient doctors, because they lived in a world in which the law-makers declared that any indifference to the law of *karma*—which this assertion obviously entails—was nothing short of heresy. The ancient Indian doctors, however, could not help this. Their science and the law of *karma* did not go together.

This becomes all the more obvious when they defend the intrinsic efficacy of medical science in i.10, which again totally ignores the view of *karma* and *adṛṣṭa*. The question of *karma* and

medicine is also squarely faced in the Buddhist text *Milindapañho* where Nāgasena says in so many words that the causes of disease and their cure are exempted from the otherwise all-pervasive law of *karma* (SBE xxxv. 190-5).

IRRELEVANCE & CONTRADICTION

With the clarification of the above points, let us return to our medical compilation.

There is thus nothing vague about what is meant by the specific medical context. It is the context that allows the discussion of four and only four factors : the doctor, substances (drugs or diets), nurse and the patient. Therefore, according to the criterion embodied in the *Caraka-saṃhitā* itself, *any discussion about anything else is redundant from the medical viewpoint. Such redundance has by all means to be avoided, because, if allowed in the medical context, it results only in flat contradiction.*

Only one clarification needs to be added to all this. When the physicians discuss the patient, they have no scope to take notice of any indwelling spirit or soul. Even though something like that is real, the physician with his substances and nursing attendant has hardly any scope to do anything about it. In fact, the view of the soul belongs to another context altogether, which is the context of the doctrine of liberation. In other words, that alone in which the physicians can possibly take an interest is the body or *śarīra* of the patient. The *Caraka-saṃhitā* wants to make this abundantly clear. I have elsewhere quoted same evidences of this.[8] The point being crucial for our subsequent discussion, we propose to add to these two more formulations of the *Caraka-saṃhitā* :

"Therefore, the intelligent man should specially devote himself to those endeavours which assure the well-being of the body. Verily, the body is the support of the man's well-being, since the man is established in the body. Leaving everything else, one should take care of the body, for in the absence of

8. D. Chattopadhyaya, *Science and Society in Ancient India*, Calcutta 1977, pp. 151-53.

the body there is total extinction of all that characterises embodied beings" (ii.6.6-7).

"The physician who understands the body in every respect and in its entirety and at all times, knows in its fullness Āyurveda, the source of happiness for the entire world"(iv.6.19).

SALVATION SUPERIMPOSED ON HEALING TECHNIQUE

With the points just discussed, let us quote a part of a long discourse attributed to Ātreya in the extant *Caraka-saṃhitā* :

"Listen, Agniveśa ! To one who contemplates the whole world as being in himself and himself in the whole world, with equanimity, there is born the true understanding. Inasmuch as he regards the world as being in himself, he realises that the soul, and none else, is the agent of pleasure and pain ; and inasmuch as he realises the whole world, being of the nature of activity and yoked to motivating factors etc., is as his own soul, he awakens the primary knowledge leading to liberation...

"Whatever action—mental, vocal or bodily—is not conducive to final liberation is called attachment; questioning such facts as the results of action, liberation and human survival after death, is called doubt. The notion, I am a unitary personality through all vissicitudes, I am the creator, I am perfect by nature, I am the unique conglomeration of the body, the senses, the intelligence and recollection—this is vain-glory. The mother, father, brother, wife, child, kinsman, friend, servant, etc. are mine and I am theirs—this is wrong identification. Erroneous conception of what is enjoined and prohibited, the beneficial and the harmful, and the good and the evil, is wrong judgment. The confounding of the knower and the non-knower, the original and the modification, action and inaction, is absence of discrimination...

"Inaction, which breaks the chain of causation, is the ultimate dissolution. That is the highest, the final peace ; that is the indestructible, that is Brahman and that is liberation *(tat paraṃ praśāntaṃ, tat akṣaraṃ, tat brahma, sa mokṣaḥ)*.

"We shall now describe the upward leading path of those who seek liberation. The seeker after final emanicipation, who has seen the vanity of the world, should first make his approach to a teacher, whose teaching he should then put into practice. Thus he should tend the ceremonial fire, study the sacred lawbooks, understand their meaning and taking them for his guide should mould his conduct thereby *(dharmaśāstra-anugamanaṃ tadarthāvabodhaḥ tena avaṣṭambhaḥ tatra yathoktāḥ kriyāḥ)*. ...This is the path leading to liberation ; straying from this, one is bound. Thus have

we described the upward steps...

"The peace of the liberated is spoken of by such synonyms as sinlessness, passionlessness, tranquility, the supreme, the imperishable, the changeless, immortality, Brahman and the final rest *(vipāpaṃ virajaḥ śāntaṃ paramākṣaram avyayam / amṛtaṃ brahma nirvāṇaṃ paryāyaiḥ śāntiḥ ucyate)*.

"O, gentle one ! this is that unique knowledge, having known which the sages, freed from doubt, entered the great peace, cast off delusion, passion and desire" (iv.5.7-24).

We are not concerned here with the intrinsic worth of the view expressed in the passage. It is well-known that there are other works primarily interested in the views, as there are metaphysicians and others debating over these. What concerns us here is only a simple question. It is about the frame of reference or context *(samaya)* to which the view belong. What, in the terminology of the doctors, is this context ? There is only one answer to it. The context is that of liberation or *mokṣa*. According to the principles formulated by the physicians, therefore, this discussion—like many other similar discussions—cannot have a legitimate place in the medical work, notwithstanding the fact that these are actually found in the *Caraka-saṃhitā* in the form in which it has reached us.

Anything found in the medical compilation in its present form, therefore, cannot be taken on its face value, i.e. as indicative of the actual medical views. There are many ideas and attitudes which, though embodied in it, are really extrinsic to medicine. We have to ignore or reject these for the proper understanding of the real medical core of Āyurveda. At the same time, we can perhaps explain the fact of the presence of such alien elements in the source-books of Āyurveda. Though redundant to medicine, their presence in the medical corpus is not purposeless, for they are presumably of the nature of ransom offered to the counter-ideology, without which it is not easy for the doctors to save their science. This seems to be obvious from the exaggerated piety which our text wants to demonstrate—an exaggeration which reminds us of what is called "defence reaction" in contemporary psychology. Questioning the reality of the soul, *karma*, after-life, and liberation—Ātreya is made to

declare—is downright heresy or *nāstikya*. And heresy is a sin—in fact the gravest sin conceivable : *pātakebhyaḥ paraṃ ca etat pātakaṃ nāstika-grahaḥ* (i.11.15). This is precisely what the law-makers also declare. How, then, can the law-makers continue to have contempt for the doctor when the doctor agrees to demonstrate such abject servility to them ?

This may be a way of saving science no doubt.[9] But this is also a way of allowing science to be crippled by its opposite.

METAPHYSICAL CORRELATES

According to the more conscientious scientists among the ancient doctors, propositions belonging to the contexts of ritual and liberation are not only irrelevant for medicine but are moreover contradictory to it. An important reason for this seems to be that they realise that a proposition belonging to one context is not to be viewed in its isolation. It is inextricably related to various other propositions of the same context. A concession to an alien proposition amounts also to the concession to its various correlates, and therefore ultimately to a system of ideas and attitudes going against the fundamentals of medical science. We shall briefly discuss here only one example of this from the extant *Caraka-saṃhitā*.

I have elsewhere proposed the term "counter-ideology" to mean the ideological requirement of regimented religion going bluntly against that of science.[10] Direct evidence or perception is strongly censured by the spokesmen of the counter-ideology. One of the most pointed expressions of this is to be found in the *Bṛhadāraṇyaka Upaniṣad*, where Yājñavalkya, following the

9. For a similar way in which the great astronomer Brahmagupta (born *c* A.D. 598) wants apparently to save his science by paying ransom to regimented religion, see *al-Bīrūnī's India* (Sachau), reprint Delhi 1964, ii. 107f. For detail, see also D. Chattopadhyaya, *What is Living and What is Dead in Indian Philosophy*, New Delhi 1976, pp. 257ff. and *Science and Society in Ancient India*, Calcutta 1977, pp. 355ff.

10. D. Chattopadhyaya, *Science and Society in Ancient India*, pp. 212ff.

often-mentioned priestly dictum of the *Brāhmaṇa*-literature (viz. *parokṣa-priyāḥ iva he devāḥ*, "the gods are fond of the obscure", quoted e.g., in *Ait Up* iii.14), declares : *parokṣa-priyāḥ iva hi devāḥ, pratyakṣadviṣaḥ*—"the gods are fond of the obscure, they detest direct observation" (*Bṛ Up* iv.2.2).

But the physicians feel that empirical data constitute the first and absolutely minimum precondition for science. The *Caraka-saṃhitā*, e.g., asserts, "Now of all types of evidences, the most dependable ones are those that are directly observed by the eyes" (i.27.3). The text puts repeated emphasis on *pratyakṣa-phala-dṛṣṭaḥ* or "results being directly observed". No inference, according to the text, can be legitimate which is not 'based on direct observation' or *pratyakṣa-pūrvam* (i. 11. 21). The same emphasis on the importance of direct observation is retained also in the *Suśruta-saṃhitā*, which, as it is well-known, leads the text to declare that the dissection of the corpse is a must for anatomical knowledge (*SS* iii.5.59-60). It also asserts, e.g., "A knowledgeable physician must never try to examine on grounds of pure logic the efficacy of a medicine which is known by direct observation to have a specific medical action" (*SS* i.40.12).

The system of rational medicine is, in short, impossible without admitting the primary importance of direct experience or perception. However, this is incompatible with the admission of the soul, its transmigration as determined by the law of *karma* and its liberation. In other words, any concession to the metaphysics of the soul requires the rejection—or at least very serious amendment—of the methodology of science, specially its demand for the primacy of perception or direct knowledge. The reason for this is obvious. Soul, rebirth, etc. are not proved by perception. The proofs for these are supposed to be the scriptural declarations.

Significantly, a discussion of our *Caraka-saṃhitā* designed primarily to prove the soul and its rebirth, opens with the statement that there is some doubt about it. "What is this doubt ? This is answered as follows. There are some who attach the greatest importance to direct knowledge or perception.

Since, however, after-life is not directly known or perceived, they commit themselves to its denial. There are others, again, who, because of their loyalty to the scriptures, admit after-life" : *kutaḥ punaḥ saṃśaya iti ? ucyate : santi hi eke pratyakṣa-parāḥ parokṣatvāt punarbhavasya nāstikyam āṣritāḥ, santi āgama-pratyayāt eva punarbhavam icchanti* (i.11.6).

The point is beautifully put. There is doubt about after-life because there are two views about it wanting to negate each other. One of these views, seeking sanction from perception, denies after-life. The other view, seeking its sanction, from the scriptures, accepts after-life.

What, then, is to be done in defence of the latter ? It is to censure direct evidence and eulogise the scriptural declarations. This is exactly the procedure followed by our *Caraka-saṃhitā* for the discussion in substantiation of after-life. Reckless to the requirements of science, it passes stricture on direct knowledge and glorifies scriptures. It urges one to give up the heretical view *(nāstikya-buddhi)* denying after-life, because, as it says, "the range of perception is after all limited, while that which is beyond perception is quite vast" : *pratyak-ṣaṃ hi alpam; analpam apratyakṣam asti* (i.11.7). Compared to the knowledge based on direct evidence, knowledge based on the scriptures is infinitely superior, because the scriptures are infallible. As it is put in our *Caraka-saṃhitā* : "Now, the dignity of authoritative testimony belongs in the first place to the Vedas. It has been enlarged to include all such other writings as are not against the trend of the Vedas and have been compiled by men with critical faculty and are for the good of the world and have been accepted by men of good will everywhere. These two constitute authoritative testimony. From such authoritative testimony we learn that charity, austerities, sacrifices, truthfulness, non-violence, celibacy *(brah-macarya)* are the means of attaining exaltation and liberation. Further, exemption from recurrent birth is not promised by the promulgators of the scriptural texts to any but those that have won release from spiritual failings, etc. Therefore the believers in scriptural texts should consider rebirth as establi-

shed truth in conformity to the teachings of the great sages of yore as well as of those that preceded them, all of whom were free from fear, desire, hate, greed, delusion and pride, devoted to spiritual knowledge, trustworthy, skilled in religious observances, unclouded of spirit and understanding, and possessed of divine insight" (i.11.27-29).

To this proof for rebirth or after-life, the discussion under consideration adds further evidence alleged to be based on perception and inference. But the importance of these other considerations are evidently secondary, or, as the Vedāntists put it, these other evidences are legitimate only to the extent to which they follow the scriptural one (Śaṃkara on *Br. Su.* ii. 1. 11). Thus, for example, perception allowed to have an independent efficacy of its own, leads to the denial of after-life. As following the footsteps of the scriptures, it may provide one with some additional considerations for the existence of after-life.

All this may be Vedānta but not medicine. A proposition belonging to the context of the doctrine of liberation, if allowed in the medical context, has the tendency of dragging in a number of collateral considerations, eventually ruining the very foundation of medical science. It is thus not merely the possibility of redundance against which the conscientious scientist in the *Caraka-saṃhitā* protests; he protests also against the danger of contradiction resulting from the confusion of the medical context with the context of the metaphysics of liberation or with the context of ritual discussion. Many more passages from our extant *Caraka-saṃhitā* may easily be quoted to illustrate this fallacy of contradiction.

SUMMING UP

The *Caraka-saṃhitā* is nothing if not a work on medicine. Medicine, as understood by it, depends on four factors : doctor, substance, nurse and patient. Propositions discussing these and these alone belong to the medical context. According to the rules formulated by some ancient doctors, ideas and atti-

tudes that belong to other contexts—specially to the contexts of ritual *(karma-kāṇḍa)* and liberation *(jñāna-kāṇḍa)* of the Vedic tradition—if allowed in medical discussion, results in the fallacy of contradiction.

But the only form in which the medical compilation reaches us is full of alien propositions like these. These are, therefore, to be viewed as extrinsic to medicine, loosely interpolated into the medical work.

When we scrap these and concentrate on the hard core of medicine contained in it, we cannot but be amazed at the science-consciousness of the ancient doctors judged in its historical context, for there are grounds to think that the fundamentals of their rational therapeutics were worked out sometime before the Buddha, or, at any rate, sometime before the codification of the *Vinaya-piṭaka.*[11]

But this science-consciousness goes strongly against the ideological requirements of the hierarchical society. The custodians of the counter-ideology, interested in drawing a mystical veil on man and nature, sensed danger practically in every aspect of science-consciousness—in its secularism, its enthusiasm for rational processing of empirical data, its materialism and its democratic commitment. Hence they came out viciously against medicine and its practitioners. There is a consistent continuity in the condemnation of doctors and surgeons from *Yajurveda* to the later commentaries on *Manu-smṛti.*[12]

When the demand for the ideological requirements of the law-makers became specially oppressive, at least a section of the scientists tried to evade censorship by conceding to it, though at the cost of self-consistency. The astronomer Brahmagupta did this and the presumption is that the same was done by those through whose hands the medical compilation passed before reaching us. This seems to account for the quaint form eventually assumed by the *Caraka-saṃhitā.* To add apparent conviction to its loyalty to the norm of orthodox piety, special chapters are added to the text for loudly proclaiming the theory of soul and its salvation.

11. *Ibid* pp. 323ff. 12. *Ibid* pp. 211-250.

Fortunately, all this did not go to the fanatical extent of destroying what had once been achieved by the ancient doctors. These survive under the heap of intellectual debris eventually dumped on them.

What proved fatal for the creative development of Indian medicine was the gradual erosion among the later doctors of the sense of total incompatibility between science and counter-ideology in the source-books of Indian medicine. They attached a sheer pragmatic value to the ancient drugs and decoctions and, practically oblivious of the marvellous science potentials or the theoretical achievements of the ancient doctors, went on dogmatically reiterating certain formulas about *vāyu*, *pitta* and *kapha*, as universal solvents of all pathogenic problems. The methodology of science once worked out was practically forgotten and so also the zeal to develop a deeper insight into man and nature, inspired by the conviction that this alone could relieve human beings from avoidable sufferings or curable diseases. What is perhaps worst is the make-believe among the later doctors that the ransom offered to the counter-ideology for protecting science belongs as it were to science itself, so that there is no difficulty in accepting Āyurveda along with the entire gamut of the theory of soul, *karma*, rebirth, salvation—not to speak of the sundry suprestitions required by the law-makers. This is about the most serious internal cause accounting for the decadence and eventual collapse of Indian medicine.

OBSERVATIONS ON MEDICINE IN INDIA AND CHINA

I-TSING

ON SYMPTOMS OF BODILY ILLNESS

One should take a small meal according to one's appetite (or 'considering whether one's own body is light or heavy'), that is to say, according to the condition of the four great elements[1], *of which one's body consists.* If one's appetite be good, an ordinary meal should be taken. If one be indisposed, one should investigate the cause; and when the cause of ill-health has been discovered, one should take rest. When health is recovered one will feel hungry, and should take food first at the next light meal. Day-break is generally called 'the time of phlegm' when the juice of the night food is still hanging about the chest, being as yet undispersed. Any food taken at this time disagrees.

If, for example, one adds fuel when the fire is already flaming, the added fuel will be consumed, but if one puts grass over a fire which is not as yet blazing, the grass will remain as it is, and the fire will not even burn.

Lighter meals are allowed by the Buddha in addition to the ordinary meal; be it rice-water or rice itself, food is to be taken according to one's appetite.

If one could subsist on rice-water only, while carrying out the Law, then nothing else should be eaten; but if one wants rice-cakes which will nourish the body, one can have them without fault. Not only is it called a disease when one has a headache and lies in bed, but also the cause of a disease is brought about when eating causes discomfort to one. When sickness has not been cured by medicine, one may eat food at any unprescribed hour if this be the physician's order. 'In such case', the Buddha said, 'the food is to be given in a private

1. i.e. earth, water, fire, and air *(mahābhūta)*.

place'. Otherwise food is forbidden at an improper time. The medical science, one of the five sciences *(vidyā)* in India, shows that a physician, having inspected the voice and countenance of the diseased, prescribes for the latter according to the eight sections of medical science.

If he does not understand the secret of this *science*, he will, though desirous of acting properly, fall into mistakes. The following are the eight sections of medical science[2]. The first treats of all kinds of sores; the second, of acupuncture for any disease above the neck; the third, of the diseases of the body; the fourth, of demoniac disease; the fifth, of the *agada* medicine (i.e. antidote); the sixth, of the diseases of children; the seventh, of the means of lengthening one's life; the eighth, of the methods of invigorating the legs and body. 'Sores' (1) are of two kinds, inward and outward. The disease above the neck (2) is all that is on the head *and face*; any disease lower down from the throat is called a 'bodily' disease (3) the 'demoniac' (4) is the attack of evil spirits, and the 'agada' (5, but 6 of Āyurveda) is the medicine for counteracting poisons. By 'Children' (6, but 5 of Āyurveda) is meant from the embryo stage until after a boy's sixteenth year; 'lengthening life' (7) is to maintain the body so as to live long, while 'invigorating the legs *and body*' (8) means to keep the body and limbs strong and healthy. These eight arts formerly existed in eight books, but lately a man epitomized them and made them into one bundle. All physicians in the five parts of India practise according *to this book*, and any physician who is well versed in it never fails to live by the official pay. Therefore Indians greatly honour physicians and much esteem merchants, for they do not injure life, and they give relief to others as well as benefit themselves. I made a successful study in medical science, but as it is not my proper vocation I have finally given it up.

Further we must notice that the medical herbs in India are not the same as those of China (Eastern Hsia); those which exist in one country are not found in the other, and the mate

2. These perfectly agree with the eight divisions of the Āyurveda.

rials used cannot be treated in the same way. For instance, the *ginseng (Aralia quinquefolia)*, the Chinese fungus *(Pachyma Cocos)*, the *Tang-kuei (Aralia cordata)*, the *Yüan-chih (Polygala sibirica)*, the tubers of aconite *(Aconitum Fischeri)*, the *Fu-tsze (Aconitum variegatum)*, the *Ma-huang (Corchorus capsularis)*, the *Hsi-hsin (Asarum Sieboldii)*, and such like are the best herbs in the Divine Land (i.e. China), and are never found in the West (i.e. India). *Harītaka (yellow myrobalan)* is abundant in India; in North(India) there is sometimes the *Yu-chin-hsiang*[3] *(Kuṅkuma)*, and the *A-wei*[4] *(assafoetida)* is abundant in the western limit of India. The Baroos camphor is found a little in the islands of the Southern Sea, and all the three kinds[5] of cardamoms are found in Dvāra (-vati)[6]; two kinds[7] of cloves grow in Pulo Condore. Only the herbs above mentioned are used in India in the same way (as in China); all other herbs are not worth gathering.

Generally speaking, a disease which has befallen the body arises from too much eating, but it is sometimes brought about by much labour, or by eating again before the former food has been digested[8]; when illness is thus caused it results in the

3. *Yü-chin-hsiang* (Jap. Golden Turmeric, species of Curcuma), is not yet identified (Giles) from a Chinese source. Kāśyapa, quoting a book on medicine, says that this plant grows in Syria (Ta-ch'in), and blossoms between the second and third months, shaped like safflower, and that the flowers are picked between the fourth and fifth months. This is Sanskrit *kuṅkuma*, 'saffron'.
4. *A-wei* grows in Persia, eight or nine feet high, the bark is blue-yellow. The leaf comes out in third month, and is like the rat-ear. It has no flower or fruit (Kāśyapa).
5. The three kinds are, according to the commentator, (1) the 'grass' cardamoms, which are abundant in the Ling-nan (i.e. south of the Plum Range=Kwang-tung and Kwang-hsi), (2) the 'white' cardamoms, found in the country of Ka-ko-ra (?), also called the 'many bones', and (3) the 'flesh' cardamoms growing in the Sū-li country (W. of Kashagar), and is called Ka-kū-lok, this is not found in China.
6. See p. 10, I-Tsing (Takakusu).
7. Two kinds of cloves are Ting-tzu-hsiang and Mo-ting-hsiang (Kāśyapa).
8. Lit. 'having the morning meal before the night meal is digested, and the midday meal before the morning food is passed.'

cholera morbus, in consequence of which one will suffer from a sense of sickness for several consecutive nights, and the swollen belly will continue more than ten days. In such case, those who are rich can buy the costly pill prepared from kidneys, or the valuable glue that comes from Ta-ch'in (Syria), but those who are poor *can do nothing*, and pass away with the morning dews. What can one do when an illness has got the upper hand ? Every effort will be in vain, even if the physician of Lu come in the morning and prescribe pills and powder, or if Pien Chi'ao visit in the evening and offer a medical decoction or plaster. Cauterised with fire or with a puncture applied, *one's body* is treated just as wood or stone; except by the shaking of the legs and moving of the head, the sick differs not from a corpse.

Such *results* are indeed due to one's ignorance of the cause of disease, and the want of understanding how to remedy (lit. to moderate and protect). It may be said that people hope for recovery without ground, just like some who, wishing to stop a stream, do not dam it at its source; or like those who, being desirous to cut down a forest, do not fell the trees at their roots, but allow the current or the sprouts to increase more and more.

Those who have been learning the Sūtras and Śāstras will ever grieve, simply gazing at the *Tripiṭaka*, *being unable to pursue the study any further*, and those who have been practising the tranquillising of thoughts (i.e. *dhyāna*) will long be sighing, thinking of the eight regions of meditation (i.e. the four *dhyāna*-s and four *arūpadhātu*-s). Those who seek to advance to the 'Master of Classics' (*Ming-ching*) will have to cut off the bridles at the Gate of the Golden Horse[9], and those who are competing for the 'Advanced Scholar' (Chin-shih) will finally cease to move toward the Court of the Stone Gutter.[10] Is it not a sad

9. Chinese, Chin-ma-men ; it is the Imperial palace for scholars, the Han-lin. So called from a bronze horse placed there by Wu-ti, of the Han dynasty.

10. Chinese, Shih-ch'u-shu, the Imperial library and office of compilation; this is said to have been originally built by Hsiao-ho, minister of the founder of the Han dynasty, to keep the books spared in the Ch'in

thing that *sickness* prevents the pursuit of one's duty and vocation? It is not indeed a small matter for one to lose one's glory and favour, and I therefore describe the above, which the reader will not, I hope, object to as a lengthy repetition. I desire that an established disease may be cured without expending much medicine, and that a fresh disease may be prevented, thus not necessitating a physician;—then a healthy condition of body (lit. the four elements) and the absence of any disease may be expected. Is it not beneficial if people can benefit others as well as themselves *by the study of medicine*?

But the swallowing of a poison, or death and birth, is often due to one's former action (i.e. *karma)*; *still* it does not follow that a man should hesitate to avoid or further a circumstance *that leads to or averts a disease* in the present life.

RULES ON GIVING MEDICINE

Every living creature is subject either to the peaceful working or failure of the Four Great Elements (i.e. mahābhūta). The eight seasons coming one after another, the development and change *of the bodily condition* are ceaseless. Whenever a disease has befallen one, rest and care must at once be taken.

Therefore the World-honoured (i.e. *Lokajyeṣtha*=the Buddha) himself preached a Sūtra[11] on the Art of Medicine, in which he said: 'Failure of health (lit. moderation) of the Four Great Elements is as follows:—

1. The *Chu-lu*, i.e. making the body slothful and heavy, owing to an increase of the element earth.
2. The *Hsieh-po*, i. e. having very much eye-mucus or mouth-water, owing to an accumulation of the element water.
3. The *Pi-to*, i. e. having head and chest very feverish, owing to the overpowering heat caused by the element fire.
4. The *P'o-to*, i. e. violent rush of breath, owing to the

11. This *Sūtra* has not yet been translated into Chinese (Kāśyapa).

moving influence of the element air."[12]

These are what we call in China (1) the sinking heaviness, (2) the phlegmatic disease, (3) the yellow fever, (4) the rising breath or air (dizziness, asthma, or cold). But if we discuss sickness according to the common custom, there are only three kinds (instead of four), i.e. disease caused by the air *(vāta)*, fever *(pitta)*, and phlegmatic disease *(kapha)*, and the 'sinking heaviness' (1) is similar to the 'phlegmatic' in its condition, and accordingly the disease of the element earth is not distinguished from that of the element water. To find out the cause of illness one should examine oneself in the morning. If one

12.

	CHINESE	JAPANESE	SANSKRIT
1	*Chu-lu*	*Go-ro*	*Gulma* (or may be Guru, or *Gaurava)*.
2	*Hsieh-po*	*Sho-ha*	*Śleṣman* (=*Kapha*). Cf. Pali *Semho*.
3	*Pi-to*	*Hit-ta*	*Pitta*.
4	*P'o-to*	*Ba-ta*	*Vāta*.

Of these *Chu-lu* (1) only is difficult to be restored. *Gulma* is a 'diseased swelling of the abdomen' or 'chronic enlargement of the spleen' in medicine. Though this can well be represented by *Chu-lu*, the phonetical probablility is rather in favour of *Guru* or its derivation. We must, however, wait for a confirmation from a Sanskrit or Pali source.

As to the latter three (2, 3, 4) we have no difficulty in restoring them, for these represent what is called *Tri-doṣa*, a 'disturbance of the three humours of the body', i.e. phlegm *(Kapha* or *Śleṣman)*, bile *(Pitta)*, and wind *(Vāta)*. Buddhaghosa seems to mean these three (or four) *doṣa*-s by saying *Semhādidos'-ussanna-kāyā* in his explanation of the words *Abhisannakāyā (Cullavagga* v.14.1); *Semha* of course representing *Śleṣman*. By *Vāta*, 'wind', is meant a 'disease caused by wind,' e.g. *Udaravātābādha* i.e. 'a disease caused by wind in the stomach' *(Mahāvagga* vi.14.1). The above points are pretty well confirmed by Suśruta, Dhanvantari's pupil (who may be the man whom I-Tsing mentions as the epitomiser of the eight divisions of the Āyurveda). In his work on Medicine, i.1, Suśruta says : *Śārīrās tv annapānāmūla vātapittakaphaśoṇitasannipātavaiṣamyanimittāḥ*, 'Bodily diseases have their origin in (irregularity of) food and drink, their apparent causes being the derangement of *the humours*, i.e. air, bile, phlegm, blood, or of all these combined.'

Here *śoṇita-sannipāta* may stand for I-Tsing's *Chü-lu* (1); both seem to refer to one and the same disease, though the names differ from one another.

feels any disturbance in the four elements on inspection, then the abstaining from eating is first to be observed. Even in great thirst one must not take any syrup or water, for this is the strictest prohibition in this *science*. This abstinence is to be continued, sometimes a day or two, sometimes four or five days, until the disease has been quite cured. There will be no failure *in recovery*. If one feels that there is food remaining in the stomach, one should press or stroke *the belly* at the navel, drink as much hot water as one can, and put the finger inside the throat to cause vomiting; drinking and ejecting, one should continue the same till the remnant of food is exhausted.

Or there is no harm if one drinks cold water, and hot water mixed with dry ginger is also an excellent thing. During the day, at least, *on which the treatment is adopted*, the patient must abstain from eating, and food should be taken for the first time the following morning. If this be difficult, some other measure must be taken under the circumstances. In case of violent fever, the application of cooling by means of water is prohibited; in case of the 'sinking heaviness' (1) and 'shivering cold' the best remedy is to remain near the fire, but in hot and damp places lying south of the River (Yan-tsze) and the Range (Plum) the above rule is not to be applied, and when a fever arises in these regions, cooling by water is efficacious. When suffering from a *Feng-chi*,[13] the best remedy is to anoint the wounded and painful spot with oil, and to warm it with a heated bed-sheet. If one anoint the same with warm oil good also results. Sometimes we find that for some ten days phlegm fills the gullet, water coming incessantly out of the mouth and nose, and the accumulated breath, being enclosed in the air-pipe, causes acute pain to the throat; in such a case speaking is difficult, on account of want of voice, and all food is tasteless.

Fasting is an effective cure, without any trouble of cauterising the head or rubbing the throat. This is in accordance

13. Feng-chi, lit. 'wind-pressure', is not very clear. The commentator supposes that it is lock-jaw. I think it represents 'Vāta-ābādha', rheumatism (Childers).

with the general rule of the science of medicine[14], i. e. healing a disease without using a decoction or any medicine.

The reason is that when the stomach is empty violent fever abates, when the juice of food is absorbed a phlegmatic disease is cured, and when the internal organs are at rest and bad breath dispersed, a severe cold will naturally be over. There will be no failure in a cure if this method be adhered to.

There is, indeed, no trouble in feeling the pulse; what use is it, then, to inquire one's fate of a diviner ?

Each man is himself the king of physicians, and any one can be *Jīvaka*[15]. T'an-lan[16], the Master of the Law, used to cure disease by moderating the temperature—a thing a hermit alone can do. Hui-ssu,[17] the Dhyāna-master, destroyed an evil sickness (by meditation) while sitting in a room—a thing common knowledge can never attain to. If it be necessary to consult some famous physician in Lo-yang, the eastern capital, then the poor and needy are (on the ground of expense) cut off from the ford *of life*; and when it is a case of gathering the best herbs from the western field, the parentless and helpless will lose their way. But the fasting we are now speaking of is simple and admirable, for it can be practised equally by poor and rich. Is it not important ?

Food should be abstained from in all other diseases, such as a sudden appearance of a carbuncle or a smaller boil; a sudden rush of blood causing fever; a violent pain in the hands and feet; any injury to the body caused by heavenly phenomena (such as lightning), climate, or sword and arrow; a wound inflicted by falling down; an acute febrile disease or cholera morbus; the half-day diarrhoea, a headache, heart-disease, eye-disease, or toothache. A pill called *San-teng* (lit. the equal mixture of the three) is also good for curing several sicknesses and

14. In these chapters, the Vidyâ, not the *Vinaya*, is I-Tsing's guide; he knew something of medicine, as he himself says.
15. A famous physician in the Buddha's time. See *Mahāvagga* viii. 1. 4 *seq.*
16. T'an-lan is a patriarch of the Sukhāvatī school. Died A.D. 542.
17. Hui-ssu (E-shi) is the third patriarch of the Tien-thai sect. Died A.D. 577. See Nanjio's *Catal.*, Appendix iii. 10.

not difficult to obtain. Take the bark of *Harītaka* (or *kī)*[18], dry ginger, and sugar, and prepare the three in equal quantities; grind the former two and mix them with the sugar by means of some drops of water, and then prepare them in pills. About ten pills for one dose, every morning, is the limit, and no dieting is required. In case of diarrhoea, about two or three doses are sufficient for recovery. The benefit derived from this pill is very great, as it can relieve a patient from giddiness, cold, and indigestion; and that is why I mention it here. If there be no sugar, jelly or honey will suffice. If one bite a piece of *Harītaka* every day and swallow its juice, one's whole life will be free from disease. These points which form the science of medicine were handed down from Śakra Devendra, as one of the five sciences of India, which is followed throughout the five parts of that country. In it, the most important rule is fasting. The old translators taught that if *a disease* be not cured by abstaining from food for seven days, one should then seek help from Avalokiteśvara. Most of the Chinese were not accustomed *to such a practice*, and considered it as a separate religious fast, thus never attempting to study or practise it *as a science.* This *error* is due to want of knowledge concerning the science of medicine on the part of the *old* translators. In case of *sickness brought about* by swallowing a 'red stone' *(Tan-shih)*, a chronic illness or the swelling of the stomach, one may also adopt the above-mentioned method.

[Note by I-Tsing : I fear that there may be some who swallow a 'red stone[19]' *(Tan-shih)*; it is not a good thing to take, though it suppresses hunger. The Fei-tan (the 'flying red stone'[20]) is never found in any country *but China.* The swallowing of a stone is practised only in the Divine Land (i.e. China), but a crystal or an adularia (lit. 'white stone') sometimes produces fire; if swallowed, one's body is 'burnt and cracked.' People of these days do not distinguish this, and those who die of this

18. i.e. yellow myrobalan, *Mahāvagga* vi.6.1.
19. 'Red stone' is identified with the 'Red sand' *(Tan-sha)*, i.e. cinnabar or red sulphuret of mercury, by the commentator Kāśyapa.
20. The 'Flying Cinnabar', if swallowed, enables a man to fly (Kāśyapa).

fault are innumerable. Thus one should be deeply aware *of its danger*.

Poisons such as that of snake-bites are not to be cured by the above-mentioned method. While abstaining from food, walking and working are to be strictly avoided.

He who is taking a long journey can walk without any harm through fasting; but when *the disease for which he is fasting* is cured, he must take a rest, and eat newly-boiled rice and drink a quantity of well-boiled lentil-water mixed with some spice. If one feels chilly the last-named water is to be drunk with some pepper, ginger, or the Piper longum *(Pippali)*[21]. If one feels cold, Kashgarian onions *(Palāṇḍu)* or wild mustard must be applied.

It is said in the Śāstra on medical treatment[22] : 'Anything of acrid or hot flavour removes a cold, with the exception of dry ginger.' But if mixed with other things it is also good. One should moderate and rest the body during as many days as one has been abstaining from food. Drinking cold water is to be avoided; other dieting is to be carried out according to medical advice. If one drinks rice-water it is to be feared that the phlegm will be increased. In case of being troubled by cold, eating will not hurt one; for a fever, the medical decoction is that prepared by well boiling a bitter ginseng (the root of *Aralia quinquefolia)*.

Tea is also good. It is more than twently years since I left my native country, and this alone *as well as the ginseng decoction* was the medicament to my body, and I had hardly any serious disease.

There are in China more than four hundred kinds of herbs, stones, stalks, and roots, most of which are excellent and rare in colour and taste, and very fragrant in their smell; thereby we can cure any disease and control the temper. In the healing arts of acupuncture and cautery and the skill of feeling the pulse China has never been superseded by any country of

21. These three pungent substances make *tekaṭula* gruel, *Mahāvagga* vi. 17.1., For Pippali, see *Mahāvagga* vi. 6. 1, note 6.
22. Not identified.

Jambudvīpa (India); the medicament for prolonging life is only found in China. Our hills are connected with the Himālaya, and our mountains are a continuation of the Gandhamādana[23]; all sorts of things strange and precious are found there in abundance. From the character of men and the quality of things, China is called the 'Divine Land.' Is there any one, in the five parts of India, who does not admire China ? All within the four seas respectfully receive *the command.* They (Indians) say that *Mañjuśrī*[24] is at present living in that country (China). When they hear that one is a priest of the Devaputra, all pay great honour and respect, wherever one goes. *Deva* means 'heaven' and *putra* 'son'; the priest of the Deva-putra is more fully 'One who has come from the place where dwells the Son of Heaven of Cīna (China)[25]. We see that the herbs and

23. This mountain range, Gandhamādana, is generally translated by 'Fragrant mountain', sometimes more fully, 'Hsiang-tsui', i.e. 'Fragrant intoxicating mountain.' It is the region of the Anavatapta lake, from which the four rivers, Sītā, Gaṅgā, Sindhu, and Vakṣu (Oxus) derive their source. This lake is perhaps the Manasarowar lake (lat. 31° N., long. 81° 3) and Hiuen Thsang's identification with the lake Sirikol (lat. 38° 20N.) on the plateau of Pamir may be altogether wrong (see Eitel's *Handbook*, s.v. Anavatapta). So we should take the Gandhamādana as the high plateau north of the Himālaya, on which the lake Anavatapta lies. I-Tsing mentions this mountain again in chap. xxxiv.
24. The Indians seem to have had some impression of *Mannjuśrī*'s dwelling in China in I-Tsing's time. We meet with this statement again in chap. xxxiv.
25. The reader is reminded that the Chinese Emperor is still called the 'Son of Heaven' an old term used by Confucius or his direct disciples (B.C. 551-479). Deva-putra is a literal translation of 'Son of Heaven' (Tien-tze).

    The name, *Cīna,* which I-Tsing is using, is taken from Sanskrit, and probably is the same as *Cīna* of Indian literature. But how long this name had been used in India or from which name of China it had been taken is uncertain. It was once supposed to have been taken from the Ch'in dynasty (B.C. 222), forming a landmark in Indian chronology, but this supposition was given up by several scholars. Nothing is certain but that Cīna was used as denoting the Chinese in Hiuen Thsang's and I-Tsing's time.

stones are indeed excellent and of rare quality, but the tending and protection of the body, and the inspection of the causes of disease are very mnch neglected. Therefore I have here described the general methods *of medical treatment* in order to meet the wants of the time. When festing does not hurt at all, one should begin medical treatment according to the proper method. The medical decoction prepared from the bitter ginseng specially serves to remove a fever. Ghee, oil, honey, or syrups relieve one from cold. In the country of *Lāṭa*[26] in W. India, those who are taken ill abstain from food, sometimes half a month, sometimes a full month. They never eat until the illness *from which they are suffering* is entirely cured. In Central India the longest period of fasting is a week, whereas in the island of the Southern sea two or three days is the limit. This is due to the differences of territory, custom, and the constitution of the body.

I do not know whether or no fasting for curing a disease should be practised in China. But if abstaining from food for a week proves to be fatal, it is because disease does not remain in the body; for while a disease is in the body, fasting even for more days does not cause death. I witnessed some time ago a man who abstained from food for thirty days and recovered again. Why then should we doubt the efficacy of long fasting ?

Nor is it good to force a sick person when attacked by a violent fever to drink hot rice-water or to take food, simply noticing that he is ill but not inspecting the cause of his illness. Nay, it is a dangerous thing !

There may be a case of recovery by such treatment, yet it is not after all worth teaching people to follow. Such is strictly prohibited in the science of medicine. Further, in China, people of the present time eat fish and vegetatles mostly uncooked; no Indians do this. All vegetables are to be well cooked and to be eaten after mixing with the assafoetida, clarified butter, oil, or any spice.

People (in India) do not eat any kind of onions. I was

26. In the *Bṛhat-saṃhitā* lxix. 11, Mālava, Bharoach, Surat (Surāṣṭra), Lāṭa, and Sindhu are mentioned in one group.

tempted and ate them sometimes, but they cause pain while taking a religious fast and injure the *belly*, besides spoiling the eyesight and increasing disease, and causing the body to become more and more weak. This is why Indians do not eat them. Let the wise be attentive to my statement, and practise what is useful while giving up what is objectionable; for if one does not act according to what a physician has prescribed there is nó fault on the part of the latter.

If practised accordingly, *the method above mentioned* will bring ease to the body, and perfection to religious work, thus completing benefits both to others and to oneself. If the method be rejected, *the result* will be a feeble body and narrow knowledge, and the success of others as well as of oneself will be altogether destroyed.

HURTFUL MEDICAL TREATMENT MUST NOT BE PRACTISED

There are some places where a low custom has long been prevalent, i.e. whenever a sickness arises people use the urine and feces as medicaments, sometimes the dung of pigs or cats, which is put on a plate or kept in a jar. People call it the 'Dragon Dicoction,' which, though beautifully named, is the worst of impure filth. Even in eating onions which are allowed (by the Buddha), one keeps oneself in a separate room of one's own accord, and purifies oneself by washing and bathing for seven days before one comes among the Brotherhood. While one's body is as yet impure one never enters an assembly, one is not fit to walk round a Stūpa (tope), and must not salute or worship.

As onions have a foul smell and are impure they are not permitted to be eaten except in case of illness [27]. The healing by a 'putrid rejected substance'—one of the four Refuges [28] of

27. So *Cullavagga* v. 34. 1 and 2 (S.B.E., vol. xx, p. 154).
28. The four Refuges by which a Bhikṣu has to live are explained in the *Caturvarga-vinaya*, chap. xxxv (Nanjio's Catal., No. 1117); these are the four *Nissāyas* of *Mahāvagga* i. 30. 4, (1) *Piṇḍiyālopabhojanaṃ*; (2) *Paṃsukūlacivaraṃ*; (3) *Rukkhamūlasenāsanaṃ*; (4) *Pūtimutta-bhesajjaṃ*.

a Bhikṣu—consists in the using of a putrid and old thing which has been thrown away; the object being to economise things to such an extent that only enough is left for bare subsistence. A valuable *medicine* is, of course, open to any, and it is never wrong to take it.

Sanskrit words for 'putrid-rejected-medicine' are *Pūti-mukta* (or *-mukti)-bhaiṣajya* [29] which are to be translated by the words 'putrid or old-rejected-medicine.'

Feces and urine are permitted to be used as medicine in the *Vinaya*, but these are the dung of a calf and urine of a cow[30]. In India, those who have been condemned as lowest criminals have their body besmeared with dung and are forcibly driven out to a wilderness, being excluded from the society of men. Those who carry off feces and clear away filth have to distinguish themselves by striking sticks[31] while going about; when one has by mistake touched any of them, one thoroughly washes oneself and one's garments.

Our Great Master was in the habit of avoiding, first of all, people's murmurs and slander while managing affairs according

29. There is much controversy about the meaning of these words among the Chinese interpreters. Some would have 'Pūti-mutrabhaiṣajya', i.e. 'having urine as medicine'; this is no doubt correct. I-Tsing and others, on the other hand, would have *Pūtimukta-bhaiṣajya*, and hold that it means the old medicine which was once used and thrown away, and that it is not the same as urine or feces. I fancy that as the original Pāli words, *Pūtimutta-bhesajja* (*Mahāvagga* i. 30. 4), may stand for either *Pūti-mutra-bhaiṣajya* or *Pūti-mukta-bhaiṣajya*, thus a a difference of opinion may have arisen. *Pūti-muttam* means 'decomposing urine' (of a cow, *Mahavagga* vi. 14. 7), which is also mentioned below. Cf. the translation of *Mahāvagga* i. 30. 4, 'The religious life has decomposing urine as medicine for its resource.' The *Vinaya Text*, part i. S.B.E., vol. xiii.
30. So Buddhaghosa on *Mahāvagga* vi.14.7 : *Mutta-harītakan ti gomutta paribhāvitaṃ harītakaṃ*.
31. This statement is confirmed by Fa-hien. He says in chap. xvi of his narrative : 'Caṇḍāla is the name for those who are held to be wicked men, and live apart from others. When they enter the gate of a city or a market-place, they strike a piece of wood to make themselves known, so that men know and avoid them, and do not come into contact with them.' Legge's *Travels of Fa-hien*, p. 43.

to circumstances. Would He then allow the use of such foul things as filth assuredly in opposition to the wish of the people of His time ? The reasons why He would not do so are fully explained in the *Vinaya*. It is, indeed, mean to give others as *medicine* such *a foul substance as urine or feces*. One should not let people follow such a practice and make it a constant custom. If this be heard of by foreigners, the transforming influence of our country will be lessened. And again, why shall we not use all those fragrant herbs that exist in abundance ? *Foul substances* are what we dislike, how can we bear to give them away ? And as an antidote for snake-bites we have the 'stones' of sulphur, flowers of sulphur, and gamboge, and it is not very difficult to keep a piece by one. When infected by fever or malaria we have the decoctions of liquorice root, *heng-shan*[32], and bitter ginseng, which are not very difficult to keep prepared. Cold can always be removed by taking some ginger, pepper, and the fruit of Piper longum. Solid and dry sugar can satiate hunger and thirst when eaten. If there be nothing laid by to meet the cost of medicine, want of money is certain at the time of need. Are we free from fault if we disregard the teaching and do not practise it as we ought ? People use money lavishly and neglect to provide for imminent need; if I did not notify them, who would understand the points clearly ? Alas ! People would not take good medicine, and, seeking the least expense, would use the 'Dragon Decoction.' Though their motive may be to get some benefits from such medicine, yet they are not aware of their grave offence to the noble teaching. Some followers of the Āryasammiti school speak of the Pūti-mukta-bhaiṣajya (as being the foul substance), but of course it is a different school from ours, and we have nothing to do with it. Though the *Vinaya-dvāviṃśati-prasannārtha-śāstra* (Nanjio's Catal., No. 1139) has also a certain reference to *such medicine*, this book is not what is studied in the Āryasarvāstivāda school.

32. Lit. 'constant mountain'; it is a kind of wild tea, according to Kāśyapa.

[Translated from Chinese & annotated by J. Takakusu]

INDIAN MEDICINE AND ITS EXTERNAL RELATIONS

J. JOLLY

A continuous exchange in the domain of medicine with the neighbouring people cannot be doubted, but regarding the kind and extent of these relations very little has so far been determined.

1. *Tibet.* H. Laufer's excellent *Beitrage zur Kenntnis der Tibetischen Medicin*[1] gives a good review. From the "Four Tantras" translated (Sanskrit original unknown) in the 8th century onwards a lot of medical Sanskrit texts have been translated into Tibetan. The Tibetan medicine is, therefore, mostly based on the Indian medicine. For example, 9 openings of the body and 900 nerves are from anatomy, the theory of *tridoṣa* is carried to its logical conclusion, the harmfulness of the combination of milk and fish as well as the suppression of natural discharges are mentioned under dietetics, the three myrobalans, the blue lotus *(utpala)*, black pepper, garlic, ginger, cinnamon, root of costus *(kuṣṭha)* are referred to in pharmacology, the scarification with the horn of ox, the designation of instruments as millet-corn, bird's beak, mouth of animal etc. are mentioned in surgery, the symptoms of the sex of foetus are given under the diagnosis of pregnancy. Several Tibetan works are translated into the Mongolian. The Tibetan medicine is used by Buryats, Dzungars, Tanguts, Volgakalmuk as also by the Lepcha and other Tibetan people of the Himalayas.[2]

2. *Ceylon.* Buddhism had brought medicine to Ceylon still earlier than to Tibet. However, apart from the *Sāratthasaṅgaha*[3] known only from the continuation of the *Mahavaṃso*, the *Yogār-*

1. Two parts, pp. 41, 90, Berlin, Leipzigg, 1900.
2. l.c. p. 15, cf. Lietard, *Hist. de la Med.*, pp. 38ff.
3. On an apocryphal work of this name see Geiger, *Grundr*, 1.10. §1. cf. also Ainslie, *Materia Medica of Hindustan*, Madras, 1813, 2nd edn. London, 1826, 2, 525ff.

nava (13th century AD) appears to be the oldest medical work.[4] The modern Simhalese publications[5] and the Simhalese MSS on medicine[6] at the British Museum appear to be based throughout on Sanskrit models.

3. *Burma.* Although the fame of Suśruta had spread about 900 AD from Western India to Kamboja, *Suśruta*, *Dravyaguṇa* and other medical works were directly translated from Sanskrit into Burmese in the 18th century. The technical terms in Burmese medicine are also derived from Sanskrit.[7]

4. *Persia and Arabia.* From the Aryan antiquity originated particularly the oldest Indo-Persian terms for physician and medicine *(bhiṣaj—biziṣk, bheṣajam—baeṣazem)*, for magic spells *(mantra—mathra)*, some names of diseases and the most common names of parts of human body. Further, we find the Bactrian physician Kāṅkāyana *(bāhlīka-bhiṣaj)*[8] referred to in *Caraka* (i.12.5, iv. 6. 21 etc.) as well as in the *Bower MS* (2.935). The Persian medicinal substance *Pārasīyayavānī* is mentioned in *Siddhayoga.* Earlier than that Hiṅgu *(Asafoetida)* occurring in *Suśruta* and other works as well as the orange *(Nāraṅga)* must have been imported from Persia. In the middle age the calcination and extensive therapeutic use of quicksilver and other metals, the opium, the root of Bertram, the feeling of pulse in medical examination appear to have reached India from Arabia or Persia. Later imports of medicinal substances from Persia need not be considered here. On the other hand, Indian works on medicine were translated into Persian already in the time of Abbasians or perhaps of the Sassanians. These are not available at present. Then followed Arabic translations. Except Caraka and Suśruta, the names of translated Indian authors are difficult to identify. Yet the Arabic accounts of the contents of these works and quotations therefrom in *Rāzī* and other Arabic writers show that they deal with purely Indian product.[9]

4. Geiger, § 5. 5. Haas, *ZDMG*, 30. 631.
6. Wickremasinghe, *Cat. Sinhal. MSS*, British Museum, 1900, 55ff. (Geiger).
7. Forchhammer, *The Jardine Prize*, Rangoon, 1885, pp. 21, 104.
8. cf. Weber, *Uber Bahli, Bahlika*, Sitzungsber, 1892.
9. cf. the literature to § 5, pp. 8ff in Jolly, *Indian Medicine*.

Very much Indian material is found in the preserved Persian work of Abu Mansur Muwaffaq on pharmacology (10th century). The author himself had made a scientific journey in India and cites much from Indian works[10] which are indeed unknown.

5. *Greece*. The Indian elements in the materia medica of Dioskorides and earlier authors can be easily ascertained; e.g. peperi—*pippalī*, pepereosriza—*pippalīmūla*, costus—*kuṣṭha*, ziggiberis—*śṛṅgavera*, kardamomos—*kardama* (elā), kinnamomos—*tvaca*, akoros—*vaca*, bdellion—*guggulu*, kupeiros—*mustāka*, sakcharon—*śarkarā*, sessamon—*tila*, etc.[11] Still more difficult it is to explore the origin of many further analogies between Indian and Greek medicine.[12] To quote for example : the accomplished humoral pathology, the raw, ripening and the ripe stages of fever—*apepsia*, *pepsis* and acme corresponding to the tumour and other ailments, the division of healing remedies into hot and cold, also in dry *(rukṣa)* and oily i.e. moist *(snigdha, picchila)*, the healing of diseases by remedies of opposite character, the purely Hippocratic emphasis on prognosis, the characterization of the physicians and the directions given to them reminding us of the oath of the Asclepiads, the influence of seasons in dietetics, the recommendation of spirituous drink contrary to the religious view of the Indians, the quotidian, tertian and quartan fever, *Kṣaya* (phthisis) etc. in individual diseases, keeping in check the heart-troubles in negative bearing, the often occursensation of creeping round of ants on the body in respect of symptoms, the eating of earth in chlorosis, the simultanaeous

10. Trans. by Achundow in Kobert's *Historical Studies*, 3, 137-481. To my *Identificirung von 21 indischen drougen in Muwaffaq* printed there on pp. 294ff. many additions can be made, e.g. red and white sandal=*raktacandana, candana.*
11. cf. Royle, *An Essay on the Antiquity of Hindu Medicine*, London, 1837; German trans. by Wallach, Cassel, 1839, pp. 81ff.
12. cf. A. Webb, *The Historical Relations of Ancient Hindu with Greek Medicine*, Calcutta, 1850, p. 34; Roth, *ZDMG*, 26, 448; Haas, l.c. pp. 659ff; Weber, *Die Griechen in Indien*, Sitzungsber, 1890; Fasbender, *Entwicklungslehre* etc, Stuttgart, 1897, pp. 62-70; Lietard, *La Doctrine humorale*, *Janus*, II, 1897ff.

formation of all parts of body in the doctrine of development and midwifery, the birth of twins by the division of quantity of semen, the relation of the right part of body to the male sex of the foetus, the vitality of foetus in the 7th month and the contrary in the 8th, the dismembering of the dead foetus and its extraction with a hook fixed in the eye-sockets, the movements for the advancement of placenta, the method of lithotomy in surgery, the paracentesis in dropsy, branding, cauterizing and cutting of hemorrhoidal tumours, bleeding, leeches (among them those coming from Greece, *Yavana*, Suś. i. 13. 13) and cauteries, many surgical instruments, the operation of the right eye with the left hand and of the left eye with the right hand and other details of the operation of the cataract in opthalmology. A fragmentary MS (in the Ist cen. AḌ ?)[13] having the form reminding us of the papyrus roll is preserved besides the manifold Greek coins minted in India. That in the period when Greek influence was predominant in India, certain medical writings of the Greeks might have found admission in India is indeed as easily possible as the Greek astronomy and astrology were, as is well known, received in India.[14] Yet we must not overestimate the Greek elements. The humoral pathology which in its developed form reminds us of the Greek one, can also be connected with the harmony of the three *guṇa*-s of the Sāṃkhya philosophy and can be proved as early as the origin of the conception of the *guṇa*-s. The Greek influence must have been the strongest in the field of surgery. It is also to be noted that the *Bower MS* and *Caraka* contain nothing of surgery. In later works also surgery completely receded to the background.

[Translated from German by C. G. Kashikar]

13. Hoernle, *JASB*, 69, 1.2.126ff.
14. cf. Thibaut, *Grundr.* III, 9 § 29, 46.

ANALYSIS OF A TIBETAN MEDICAL WORK

ALEXANDER CSOMA de KOROS

The principal work on medicine in Tibet, is that entitled the *rGyud-bshi* ("the tract in four parts"). It is attributed to Śākya, though not introduced into the *bKa'-'gyur* or *bsTan-'gyur* collections.

When in Tibet I requested the Lama, my instructor in the language of the country, to give me an account of its contents, which he did in an abridged compilation divided, like the original, into four parts. The present translation of the Lama's manuscript may be interesting to those who are curious on the subject of Tibetan literature, and the state of medical practice in that remote part of the world. The materials of the original are as usual all derived from Sanskrit works, which have not however hitherto been made known in an English dress.

The following is the account given in the work itself of the manner in which this Treatise of Medicine found its way to Tibet.

In the time of Khri-sroṅ-lde-btsan (in the 8th or 9th century of the Christian era), a Tibetan interpreter Vairochana having translated it in Kashmir, with the assistance of a physician-pandit Zla-ba-mṅon-dga' presented it to the above mentioned Tibetan king. At that time it was received by a learned physician, and by several others, and afterwards it devolved successively to others till gYu-thog (the 13th in descent, from the first) styled the New gYu-thog, to distinguish him from the former physician of the same name, who is called 'the ancient'. This physician much improved and propagated it; and at that time, it is stated, nine men became learned in medicine.

The Lama, who wrote me this extract, enumerated several works on medicine, current in Tibet, of which the most celebrated is a commentary on the present work, entitled *Vaidūrya sṅon-po* (the lapis lazuli) written by Saṅs-rgyas-rgya-mtsho, a regent at Lassa about the end of the 17th century.

The Lama states that there are about forty books or works

written in Tibet on medicine, besides the five volumes in the *bsTan-'gyur* collection, and the scattered occasional instructions on medicaments in the *bKa'-'gyur.*

The chief medical school in Tibet is at Chak-phuri, a monastery at or near Lassa. There are also two others, in middle Tibet, of some repute.

FIRST PART

This is entitled *rTsa-la'i-rgyud* the root or basis of the (medical) tract. It is divided into six chapters.

First Chapter

In this is described how bCom-ldan-'das (Śākya) transforming himself into the shape of a chief physician, in a forest of medical plants, delivered his instructions, in a superb palace, in the presence of gods, sages (or *ṛṣi*-s), and a large train both of heretic and orthodox hearers.

Second Chapter

He (Śākya) addressed his audience thus :— "Assembled friends ! be it known to you, that every human creature who wishes to remain in health; and every man who desires to cure any disease, and to prolong life, must be instructed in the doctrine of medicine. Likewise, he that wishes for moral virtue, wealth, or happiness, and desires to be delivered from the miseries of sickness; as also, he that wishes to be honoured or respected by others, must be instructed in the art of healing." Then one of the hermits or Ṛṣi-s (Draṅ-sroṅ) expressing his desire of promoting the well-being of others, requested his advice as to the manner in which he might become instructed in the doctrine of medicine. Then the teacher (Śākya) said : (or commanded :) "He must be instructed in the four parts of the medical science, which are the root or theory, explication, instruction, and lastly manual operation; further he must be instructed in the eight branches of healing; viz. 1, the curing of the wholebody; 2, of particular diseases, incident to children; 3, to women; 4, the curing of diseases caused by evil spirits; 5, of wounds made by a knife, spear, etc.; 6, of all sorts of venom-

ous or poisonous infections; 7, of the infirmities of old age; and 8, the increasing of virlity in men. These are the principal divisions of the whole medical treatise."

The number of chapters in the four parts of this medical tract, amount to 156.

In the explanatory part, there are 11 places or sections, and 31 chapters; in the instructive part on cures or remedies for each specified disease, there are 15 circumstances and 92 chapters; the last part has four divisions and 27 chapters.

Third Chapter

The theory of the human constitution is illustrated by a similitude taken from the Indian fig-tree. Thus, there are three roots or trunks; thence arise nine stems; thence spread 47 boughs or branches; thence 224 leaves; two blossoms, and three fruits. The explication of the simile is applied to the states of the body. The single root or basis of diseases; the stems, branches, and leaves arising thence, taken or considered in a healthy and in a diseased state. Distinctions with respect to wind; *ditto*, with respect to bile; as also to phlegm; their respective offices, operations or influences.

There are seven supports of the body on which life depends : the chyle, blood, flesh, fat, bone, marrow, and semen. Description of the three sorts of excretions or sordes of the body : ordure, urine and sweat.

The three generative causes of disease are : lust or ardent desire; passion or anger; dullness or ignorance. By the first is caused wind; by the second, bile; by the last, phlegm. The accessory causes of disease are four : 1, season with respect to cold and heat; 2, any evil spirit; 3, wrong use of food; and 4, ill conduct of life.

The parts of the body, commonly subject to diseases, are six : the skin, the flesh, the veins, the bones, the viscera and the bowels."

The proper places of the three humours are : that of the phlegm in the upper part of the body, as the proper place of dullness, in the brain or skull; that of the bile, in the middle part of the body, which is appropriate to anger; and the wind

resides in the lower part of the trunk, in the waist and loins, as in its proper place.

There are 15 ways or channels through which disease spreads itself. The channels of the motion of wind are : the bones, ear, skin, heart, artery and the guts. The blood, sweat, the eye, the liver, the bowels are the ways or vehicles of bile. The chyle, flesh and fat, marrow and semen, ordure and urine, the nose and the tongue, the lungs, the spleen, and the kidneys, the stomach, and the bladder, are the vehicles for the conveyance of the phlegmatic humour.

With respect to the three humours, this further distinction is made : wind is predominant in the diseases of old people; bile, in those of adolescents or youths; and phlegm, in children.

With respect to place (or part of the body) : wind occurs in the cold parts of the body; bile in the dry and hot parts; phlegm abides in the moist and unctuous parts.

The several seasons, in which the diseases caused by any of these three humours prevail, are thus stated : diseases caused by wind arise commonly during the summer season, before the dawn, and about mid-day. Those caused by bile, in autumn, about mid-day and mid-night. Phlegm prevails during the spring season, and in the morning and evening.

There are specified nine sorts of diseases, in which there is no hope of recovery.

On the 12 causes by which any of the diseases caused by any of the three humours, is changed into another, as wind into bile and phlegm, etc.

All diseases are classed under two heads : heat and cold. Those, in which wind and phlegm prevail, being of natural water, belong to cold. Blood and bile, being of natural fire, belong to heat. The diseases caused by the worms and the serum, belong both to cold and heat.

Fourth Chapter

On the symptoms of diseases. On examining the tongue and urine. On feeling the pulse. On asking (orally) after the circumstances, how the disease first arose, and its progress—what pain is felt, what sort of food has been useful or noxious ?

Especially with respect to the tongue : If the tongue is red, dry, and rough, it is the sign of prevailing wind; if covered with a yellowish white thick substance, it is the sign of bile; if covered with a dim, white, soft, and moist substance, it is the sign of phlegm.

With respect to the urine : If the urine of the patient is blue, clear like springwater, and has much spume or froth, it is the symptom of wind; if yellowish red and thick, steaming or vapouring greatly, and diffusing a smell, it is the sign of bile; if white, with little smell, and steam or vapour, it is the sign of phlegm.

With respect to the pulse : When the physician feels the pulse, if beating greatly upwards it somewhat stops (if irregular), it is the sign of wind; a quick full beating is the sign of bile; a sunk, low, and soft beating is the sign of phlegm.

The physician's 29 questions to the patient about his food, exercise, and the pains or relief felt after having taken such and such a food, made such and such an exertion, etc. are here detailed.

Fifth Chapter

On the means of curing diseases.

1. With respect to food :

The several sorts of flesh, grain, vegetables, and liquids employed successfully in curing diseases caused by wind. Specification of the several sorts of animal and vegetable food, and of soup and liquids or potions, by which bile is cured. *Ditto* of those that are good against phlegmatical diseases.

2. With respect to one's conduct of life or exercise :

It is good against wind to remain in warmth, and to have a companion with whom one can best agree. Against bile : to remain in a cool and still place, or undisturbed. Against phlegm : to cease from exertion or business, and to remain in warmth.

3. With respect to medicaments to be used against these three humours :

Those against wind are of three different tastes : sweet, sour, and saline; and with respect to their efficacy—unctuous,

heavy, and soft.

Those used against bile are : sweet, bitter, and nauseous bitter; their efficacy—coolness, thinness, and dullness, or bluntness.

Those used against phlegm are : hot, sour, and acrid; their efficacy—sharpness, roughness, and lightness.

Mixtures of medicaments with respect to their tastes; for assuaging pains, and for carrying off diseases, or for purging.

1. Assuaging medicaments :

Against windy diseases : soup and medical butter (a kind of syrup).

Against bile : liquid medicine and powder.

Against phlegm : pills and powdered medicine (aromatics ?).

The several kinds of soup are : of bones, flesh, butter, molasses; of wine, etc.

There are specified five kinds of syrup, according to the different principal ingredients, their several applications and effects.

2. Depuratory or purging medicaments :

In windy diseases—a gentle depuratory medicament.

In bilious diseases—a purging physic.

In phlegmatic diseases—emetics.

With respect to the first there are specified three sorts of depuratory medicaments, the purging medicaments are of four kinds, the emetics are of two sorts.

With respect to physical (or chirurgical) operation : against wind—the smearing of the body with butter, etc. and cauterising in the Hor (or Turkish) manner. Against bile—phlebotomy, and cold water (or bathing in *ditto*). Against phlegm—warm applications, and cauterising.

Specifications of the several kinds of cures against wind, bile and phlegm. They amount to 98 (compared to so many leaves). If the physician is skilful and diligent in his application, and the patient obedient and respectful, so will the latter soon be delivered from disease.

Sixth Chapter

Recapitulation of the three last chapters. According to the

former metaphor or allegory of the Indian fig-tree, there are three roots (or trunks) : 1, the root, place, or ground of the disease; 2, that of the symptoms, and 3, that of the manner of curing.

There arise from the first trunk (or root) two stems : that of the unchanged state of the body, and that of the changed or diseased state of the body.

From the 2nd trunk (or root) there arise three stems, namely, those of looking on, feeling, and asking (or of inspection of the tongue and urine; of the feeling of the pulse; and of asking after the circumstances of the disease).

On the 3rd trunk there arise four stems : those of the food; of the manner of living or conduct of life; of the medicaments used; and of the operations performed. Therefore, from the three trunks (or root) their arise nine stems.

The number of the boughs or branches :

Those branching from the stem of the unchanged body are : disease, the seven supports of the body, and the faeces.

On the stem denoting the changed or diseased state of the body, there are the following 9 boughs : cause of disease, accessory causes, beginning of injured parts, place, way, time of arising (or of the fit), fruit or consequence, causes of transition from one into another disease; the reduction of all diseases to heat and cold.

On the stem denoting the symptoms of diseases, there arise the following eight boughs : 2 of inspecting the tongue and urine. Of feeling the pulse, there are 3 : wind-pulse, bile-pulse, and phlegm-pulse. And in asking after the circumstances of the disease, there are 3. Altogether eight.

On the stem denoting the manner of curing, there arise the following boughs or branches : 3 of food or meat; 3 of drink or potion; 3 of the manner of living or of the conduct of life; 6 of physic with respect to taste and efficacy; 6 of the assuaging mixtures, with respect to taste and efficacy; 3 of depuratory physic. There are also 3 boughs of medical (or chirurgical) operations. Thus in all there are forty-seven boughs or branches.

The number of leaves (or of leafy branches) issuing from the 47 boughs :

1st. On the top of the unchanged stem, the enumeration of 25 diseases.

2nd. On the top of the stem denoting the changed or diseased state of the body, 63 symptoms or tokens of indisposition.

3rd. On the top of the stem of inspection (or examination of the tongue and urine), 6 branches or leaves of inspection.

4th. On the top of the stem of feeling, three sorts of pulse (or three manners of beating of the pulse).

5th. On the top of the stem of asking the patient about the circumstances of the disease, 29 questions.

6th. On the top of the stem denoting the food (diet, meat, and drink or potion) of the patient, there are the enumeration of such, as : 14 in respect to wind; 12 to bile; and 9 to phlegm.

7th. On the top of the stem of the conduct of life, 6.

8th. On the top of the stem of physic nine tastes and nine efficacies are enumerated, together 18; 3 kinds of soup or broth; 5 kinds of medical butter or syrup; 4 kinds of potions; 4 kinds of powders; 2 kinds of pills; 5 kinds of physic.

9th. On the top of physical (or chirurgical) operations, 7 leafy branches.

A summary exhibition of the above specified leaves :

1. On the trunk denoting the place and ground of diseases, there are 188 leaves.

2. On that denoting the symptoms, 38.

3. On that denoting the manner of curing, there are 98 leaves. Altogether making 224.

There are two blossoms : health and a long life.

There are three fruits : moral perfection (or good morals), wealth, and happiness.

These are the contents of the six chapters of the first part of this medical tract.

SECOND PART

There are four things to be treated of in the doctrine of curing or healing: 1, What is to be cured or healed ? 2, With what is it to be cured ? 3, In what manner is it to be cured ? 4, By whom is it to be cured ?

1st Chapter

With respect to the first question, What is to be cured ? the answer is : the disease in the human body. 2, By what means : By diet or regular food, exercise, medicament, and by chirurgical operation. 3, In what manner is it to be cured—so that the patient recovering from his sickness, may remain long alive ? To this place belongs the examination of the symptoms, the rules of curing, and the manner in which the cure is performed. The contents of this part of the treatise are reduced to four roots, and to 11 branches or minor parts.

2nd Chapter

Cure is ordained for the well-being of the body. The origin or generation of the body. Cause, and accessory causes thereof. Tokens or signs of birth.

The cause of the generation of the body is stated to be : the father's seed, the mother's blood, and the arising of consciousness. If the first be predominant, there will be born a son; if the second, a daughter; if both are equal, then a hermaphrodite. Should it happen that the blood be formed into two masses, then twins will be born.

Out of the semen are formed : the bone, the brain, and the skeleton of the body. Out of the mother's blood are generated the flesh, blood, heart, with the other four vital parts, (lungs, liver, spleen, kidneys) and the six vessels or veins. From the soul or vital principle arises consciousness through the several organs.

After the body has been thus conceived, the cause of its increase is in the two veins on the right and left sides of the womb, in the small vessel containing the mother's blood for menstruation, and in the chyle formed from the mother's food, which successively descending into the womb, concurs to the

coagulation or union of the semen, blood, and the vital principle, and to their increase, in the same manner, as water is conveyed, by certain canals, from a watering pond, to a field, for the production of corn.

The body, by the agitation of the (inward) air, being changed during 38 weeks, goes on continually increasing, for nine months.

The continual increase of the foetus, or embryo, is thus: In the 1st week, it is like a mixture of milk and blood. In the 2nd week, growing somewhat thick, it is of a ropy or tenacious nature. In the 3rd week, it becomes like curds. In the 4th week, from the form, which the embryo takes, is conjectured whether it will be a son, daughter, or hermaphrodite. In the 1st month, the mother suffers both in her body and mind several disagreeable sensations.

In the 2nd month, in the 5th week, the navel of the body is first formed. In the 6th week, the vital vein (or artery), depending on the navel. In the 7th week, the forms of both eyes appear. In the 8th week, in consequence of the forms of the eyes the form of the head arises. In the 9th week, the shape of the upper and lower parts of the trunk or body is formed.

In the third month, in the 10th week, the forms of the two arms and sides (or hips) appear. In the 11th week, the forms of the holes of the nine organs become perceptible. In the 12th week, the five vital parts (heart, lungs, liver, spleen, veins) are formed. In the 13th week, those of the six vessels.

In the 4th month, in the 14th week, the marrows in the arms and thighs are formed. In the 15th week, the wrists of the hands and the legs of the feet are perceptible. In the 16th week, the 10 fingers and the 10 toes become visible. In the 17th week, the veins or nerves, connecting the outer and inner parts, are formed.

In the 5th month, in the 18th week, the flesh and fat are formed. In the 19th week, the tendons or sinews and the fibres are formed. In the 20th week, the bone and the marrow of the feet are formed. In the 21st week, the body is covered with a skin.

In the 6th month, in the 22nd week, the nine holes of the organs are opened. In the 23rd week, the hair on the head and on the body, and the nails commence to grow. In the 24th week, the viscera and vessels become entirely finished; and then pleasure and pain is felt. In the 25th week, the circulation or motion of air or wind commences. In the 26th week, the memory of the mind begins to be clear.

In the 7th month, the 27th to the 30th week, the whole body comes to entire perfection, or is completely formed.

In the 8th month, from 31st to 35th week, the whole body, both within or without, greatly increses.

In the 9th month, in the 36th week, there a rises a disagreeable sensation in the womb. In the 37th week, there arises a nauseous sensation. In the 38th week, the head turning to the entrance of the womb, the birth takes place. But, though the months are completed, yet, on account of the mother's menstruation, and of wind, birth may for some time be delayed.

Further it is stated, that if the right side (of the pregnant woman) is high, and the body light, there will be born a son; if the left side is high, and the body heavy, then a daughter; if they both are in an equal state, an hermaphrodite. And if the middle or both the sides are high, then twins will be born.

The tokens and circumstances of approaching birth are then described.

(This may be seen at large, in the *bKa'-'gyur*, in the work entitled *dGa'-bo-mňal-'jug* (Nanda entering into the womb).

3rd Chapter

The several members of the body are likened to certain things, 32 in number.

The manner of the existence of the body, under four distinct heads : 1. The quantity (in measure or weight) of the several constituent parts of the body, and the manner of existence of those parts on which the body depends. 2. The state of the veins and nerves. 3. On the nature of diseases, the enemies of the body. 4. The holes or openings for the circulation of the air, etc.

With respect to the 1st :

1. The quantity of the wind or air (in the body) is equal to one full bladder : that of the bile to the quantity of ordure once discharged ; that of the phlegm—to one's three two-handfuls (the two hands three times full); that of the blood and ordure to seven *ditto*; that of the urine and serum to four *ditto* ; that of the grease and fat to two *ditto*; that of the chyle and the semen to one handful; that of the brain to a single handful; that of the flesh=500 handfuls; (one handful being as much as can be enclosed once in a single hand). Women have an excess of 20 more on account of their thighs and breasts.

There are 23 sorts of bones; in the back-bone, 28 are distinguished. There are 24 ribs; 32 teeth; 360 pieces of bones. There are 12 large joints of limbs—small joints, 250. There are 16 tendons or sinews, and 900 nerves or fibres; 11,000 hairs on the head; 11 millions of pores of the hair on the body. There are five vital parts (or viscera) (as the heart, lungs, liver, spleen, and the reins or kidneys); six vessels, and nine openings or holes. In Jambudvīpa the measure of a man's height is one fathom or four cubits—deformed bodies have only 3½ cubits, measured by their own.

4th Chapter

With respect to the 2nd section, showing the state of the veins. There are four kinds of veins or nerves : 1, that of conception; 2, of sensation; 3, of connexion; and 4, that of vitality.

The 1st : From the navel there arise or spread three veins or nerves, one of them ascends to the brain, and is acted on by the dull part of it, generating the phlegm in the upper part of the body. Another nerve (or vein) entering into the middle, forms the vital nerve, and depends for its existence on the vital nerve of passion and blood; that part of it, which causes bile, resides in the middle. The third nerve (or vein) descends to the privy parts, and generates desire both in the male and female. That part of it, which produces wind, resides in the lower extremity.

The 2nd : There are four kinds of the nerves of existence or sensation.

For rousing (or exciting) the organs, in their proper place, there is in the brain a principal nerve, surrounded with 500 other smaller ones. Another nerve for making clear the organ of recollection or memory, resides in the heart, surrounded with 500 other smaller ones.

That nerve, which causes the increase and renovation of the aggregate of the body, resides in the navel, surrounded with 500 other smaller ones.

That nerve, which causes the increase of children, and descendants, resides in the privy member, together with 500 other smaller ones—and comprehends or encompasses the whole body.

The 3rd : The nerve of connexion consists of two kinds, white and black. There are 24 large veins (or nerves), which, like as so many branches ascending the principal stem of the vital principle, serve for increasing the flesh and the blood. There are eight large hidden veins or nerves for making the connexion of the diseases of the viscera and vessels.

There are 16 conspicuous veins connecting the outward limbs, and 77 others spreading from them, called 'bleeding veins' (that may occasionally be opened to let out blood).

There are 112 hurtful or pestilential veins (or nerves) ; of a mixed nature, there are 189 others. Thence originate 120 in the outer, inner, and middle parts, that spread into 360 smaller ones. Thence smaller ones encompass the body as with a net-work.

There are 19 strong working nerves, which, like roots, descend from the brain, the ocean of nerves; from among them there are 13 that are hidden, and connect the intestines—six others, connecting the outward parts, are visible; from them spread 16 small tendons or sinews.

There are three vital nerves (or veins) in a man. The one encompasses both the head and the body; the second, associating with respiration, moves accordingly; the third is the principal, and connecting the veins or canals, for the circulation of air and blood, is occupied with generating or increasing the body, and being the vital nerve, is called, by way of eminence,

the artery or the principal vital nerve.

With respect to the third point :

Diseases of consequence happen in the flesh, fat, bone, tendons, nerve, intestines, and veins.

Such diseases are counted in the flesh, 45; in the fat, 8; in the bone, 32; in the tendons or sinews, 14; in the intestines, 13; in the veins, 190. On the head, there are 62; on the neck, 33; in the trunk of the body, 95; in the four hanging members (two hands, two feet), 112. Thus important diseases are reckoned 302, of which 96 are said to be very dangerous, which cannot be cured by any expense or skill. There are 49 that are dangerous in a middle degree, but which may be cured by learned physicians. The rest may be cured by others also; since they are of no great consequence, though they also be reckoned among diseases of magnitude.

With respect to the fourth point :

Of the several orifices or passages for the conveyance of air, blood, drink and food, both within and without, are enumerated 13 in males and 16 in females.

Through inconvenient food and exercise, these passages being hurt, there arises a distemper of the body, by the humours being either too much increased, issued, or hindered; or by taking wrong direction, confusion is produced. When the passages are clean, and free from any hurt, then the body is in a healthy state.

5th Chapter

Characteristic description of the body. There is a two-fold division : 1, Those parts which are subject to injury (the body). 2, Those things by which they are injured (bad humours or diseases). First, of those that are subject to injury. These are thus distinguished : the supports (or those parts which keep the body together), seven in number; as, the chyle, blood, flesh, fat, bone, marrow and semen. Excrements, as ordure, urine, and sweat; also the dirt of the teeth, and under the nails, and the impurity issuing from other openings or passages.

Firstly. The office of the seven supports of the body, and of the three excrements, is thus described :

The meat and drink, after being digested in the stomach, are changed into chyle and faeces. These turn into ordure and urine, that is, for the nutrition of the body, by increasing the blood. The blood preserving the moisture or humidity of the body, keeps up life, and increases the flesh. The flesh covering and cleansing the body, both within and without, produces the fat. This makes the whole body unctuous, and causes the increase of the bone. This supports the body and increases the marrow. This improves the essential sap of the body, and produces the semen virile. This conduces to the well-being of the whole body, and to the production of a new one.

The service, rendered by the faeces, is : the ordure serves for the support of the bowels, guts, etc. By urine, morbid humours are carried off; and it serves also for a support of the thinner faeces, and carries off the putrid thick sediments.

The office of sweat is to soften the skin, and to change the obstructed pores of the hair of the body.

Fire-warmth is the common gentle warmth, or heat, of the whole body. The warmth of the stomach is the principal cause of the digestion of meat and drink of every kind. If this warmth is in good state, the digestion of meat and drink is easy; no diseases then arise, the lustre of the face, the chyle, the supports of the body and life, then increase. Therefore, the warmth of the stomach must be kept up (or if lost, must be restored), with every endeavour.

The manner in which meat and drink are changed. Whatever is eaten or drunk, is carried into the belly or stomach, by the vital air or wind; afterwards, by the aid of phlegm, it comes into fermentation of a sweet taste, and increases the quantity of phlegm. Afterwards, being digested by the aid of bile, taking a hot and sour taste, it produces bile. Afterwards, by the aid of the air or wind that conveys an equal heat to the whole body, the dregs or faeces being separated, and taking a bitter taste, it generates thin wind. The faeces being changed into thick (or solid) and thin (or fluid) parts, become ordure and urine.

The chyle, after having passed by nine veins from the

stomach into the liver, it becomes or changes into blood; afterwards, successively, it is transformed into flesh, and the seven supports of the body.

Secondly : The hurtful things or bad humours. These are three : wind, bile, and phlegm, each with a five-fold division.

1. Of Wind. The life-keeping wind or air resides in the upper part of the head; that which operates upwards, has its place in the breast; that which pervades or encompasses all, resides in the heart; that which communicates or conveys an equal heat to the body, has its seat in the stomach; that which cleanses downwards, abides in the lower part of the trunk.

2. Of Bile. The digesting bile resides in the stomach, between the digested and indigested part; that which forms the chyle, resides in the liver; that which prepares or increases, in the heart; that which assists the sight (or causes to see), in the eye; that which gives a clear colour, resides in the skin.

3. Of Phlegm. The supporting phlegm resides in the breast; the masticatory, in the indigested part; the tasting, on the tongue; the refreshing (or that makes contented), in the head; the conjunctive or uniting, resides in every juncture (or joint).

The characteristic signs of the above-specified humours—that of wind : roughness, lightness, cold, smallness, hardness, and mobility.

That of bile : unctuousness, sharpness, lightness, foulness, depuratory moisture.

That of phlegm : unctuousness, coolness, heaviness, and dullness, softness or gentleness, steadiness, adhesion, passionateness.

6th Chapter

On the works or action of the body. These are the body, the speech, and the mind. Virtue, vice, and undetermined cases. The five organs occupy their own place. The body is divided into basis (ground or support), age, nature (or constitution), division of diseses. The basis has a triple division.

Age also has the same number; that of nature or native disposition, has seven. With respect to disease, the distinctions are : indisposition, and absence of morbid state.

7th Chapter

On the tokens of destruction (or approaching death) of the body : 1. Tokens of a far distant death. 2. *Ditto* of a near one. 3. Uncertain and 4. Certain tokens of death. Distant tokens are : any envoy (of death), dream, and change (by age) etc.; the near tokens are distinguished into near and very near. Uncertain tokens : as, when after recovering from a sickness, one may live yet many years. Certain tokens, as, when the disease is incurable.

A physician should be well acquainted with the tokens of death; that he may know whether the patient be curable or incurable, and to perform his medical service accordingly.

8th Chapter

On the increasing and decreasing state of sickness. Here is treated of the causes and accessory causes of the disease; the manner of its origin; the diseased part; the character and distinctions of the importance of each.

The causes are proximate, and remote.

9th Chapter

There are three accessory causes that depend on the primary cause : the originating and spreading, the gathering together and arising; and the taking away of the disease.

10th Chapter

On the manner in which any disease takes place in the body.

11th Chapter

On the character of diseases; as, an increasing, diminishing, and a perplexed, disease. The causes of which are to be sought in the too great or too small quantity of the three humours, of the seven supports of the body, and of the faeces.

12th Chapter

Division of diseases; with respect to the cause, the individual, and the kind of disease. With respect to the cause : this is attributed to the vicious three humours of this life; to

the consequence of immoral actions in former generations or lives, and to a mixture of both. With respect to the individuals : they are, man, woman, child, old persons; and men of every description. The several diseases peculiar to each are enumerated. The number of the kinds of the common d'seases is stated to be 404, which are divided or distinguished out of several respects. As with respect to the vicious humours, principal humour, place or injured part, and the kind of disease, 42 belong to wind, 26 to bile, 33 to phlegm. Thus with respect to the humours, 101 divisions are made, and so on; with respect to the other points also, many distinctions or classifications are enumerated, each amounting to 101.

13th Chapter

With respect to the conduct. What course of life is to be taken (to be free from disease) : 1. continually, 2, at certain periods, and 3, occasionally, or as circumstances may require. The two first are treated in the next two chapters : 1, continually to be done are : worldly affairs and religious exercises or occupations; first, the leaving off every immoral action committed by the body, speech, and the mind; and the doing of such things as are agreeable to these, in every circumstance of life : as in eating, walking, sitting, mounting a horse, sleeping, etc.

2, Religious occupations are the exercise of moral virtues, and the desisting from the ten immoral actions.

14th Chapter

On the periodical conduct of life, according to the different seasons (as the first and last part of winter, the spring, the hot season, summer, and autumn) : with respect to diet, exercise, medicine, and chirurgical operations.

15th Chapter

On the circumstantial conduct of life, with respect to several cases, teaching that, one should not obstruct hunger and thirst (or abstain from meat and drink): not hinder yawning or gaping, sneezing, breathing, coughing (or ejecting phlegm), spitting, sleeping, nor any of the natural discharges, since the obstruction or hindrances of them may give rise to any disease,

of which several cases or examples are enumerated.

16th Chapter

The manner of using meat and drink : 1. The several kinds of food, and the manner of using them. 2. Several kinds of food that do not agree, and therefore may not be used together. 3. Temperature to be observed.

For food are used : grain (or corn), flesh, butter, vegetables or greens, and dressed victuals. There are two kinds of grain : 1, growing in ears, and 2, in pods (as pulse). Flesh or animal food of eight kinds or sorts. Several kinds of unctuous or oily substances; as, butter, oil pressed from grains, kernels, fruits, berries, and trees or shrubs; grease, fat, marrow etc. To vegetable or green things belong potherbs etc. To dressed victuals or meals belong boiled rice, soup etc. Drinkable things are milk, water, wine etc.

17th Chapter

Enumeration of several kinds of food that it were dangerous to take together; as, fish and milk etc.

18th Chapter

On the proper measure of food to be taken, or on temperance in meat and drink.

19th Chapter

On pharmacy, or the preparing of medicaments for healing any disease. Taste of medicament, efficacy, digestive quality, mode of composing etc. appropriate to any specified disease.

20th Chapter

On materia medica, the efficacy of every simple medicament. The materials for medicaments are : precious and natural stones, earths, woods, vegetables, and those obtained from animals. In the text, and in another quoted work, 915 articles are enumerated, and stated of each to what disease it may be applied especially, as a remedy.

21st Chapter

Specification of the classes of medicaments; their preparation and application to specified diseases.

22nd Chapter

On the five sorts of (chirurgical) instruments, employed in

trying or sounding any disease, in cutting etc.

23rd Chapter

That one may remain in health and ease, rules are prescribed to be observed.

24th Chapter

Discrimination of the humours as the cause of any inward or outward disease.

25th Chapter

When the former are insufficient, it is taught, to seek it in the vicious inclination of the mind.

26th Chapter

To exhibit medical help, when the disease may be healed; and to give it up, when it cannot be cured.

27th Chapter

On the manner of curing diseases. How ? by whom ? with what ? The measure or length of time of curing.

28th Chapter

Detailed description of the curing of diseases.

29th Chapter

Common and peculiar mode of curing diseases.

30th Chapter

How to cure wind, bile, phlegm, is separately exposed or taught.

31st Chapter

The requisite qualities in a physician, that he should be well acquainted with the theory and practice of medicine; and be an impartial, upright, good-hearted man.

THIRD PART

Containing a full explanation of Diseases. [Containing the following chapters] :

1. Exhortation to the teacher (Śākya) to deliver a treatise or oral instruction on the manner of curing diseases.

2. The curing of diseases arising from wind (or windy humours). There are five distinctions : 1, causes; 2, accessory cause and effect; 3, division; 4, symptoms; 5, manner of curing

(diseases arising from wind).

3. In the curing of diseases arising from (or caused by) bile, there are the following distinctions : 1, cause; 2, accessory cause and effect; 3, division; 4, symptoms; 5, manner of curing; 6, and stopping or hindering its progress.

4. In the curing of diseases caused by phlegm (or phlegmatical humours), are considered : cause, accessory cause and effect, division, symptoms, and manner of curing.

5. In the curing of diseases caused by the gathering together of the three humours (wind, bile, phlegm) and of blood, there are the following distinctions or considerations : cause, incident or accessory cause and effect, place, time, kind or genus, symptoms, manner or mode of curing, and the stopping of it for the future.

6. In the curing of indigestion, the root (or primary cause) of inward diseases, there are the following distinctions or sections : cause, incident or accessory cause and effect, manner of its arising, division, symptoms, remedy or mode of curing.

7. In the curing of a swelling (or a hard conglomeration or excrescence), there is treated of : cause, incident, division, place, manner of arising, symptom, mode of curing it.

8. The curing of white swellings, a kind of dropsy. Here are considered : cause, incident, division, symptom, mode of curing.

9. In the curing of another kind of dropsy there are the same distinctions as before.

10. The curing of dropsy is taught, by exposing the cause and incident, division, manner of arising, symptom, mode of curing, stopping or cessation.

11. In the curing of phihisis or consumption of the lungs, there are the following distinctions : cause, and accessory cause or effect, division, symptom, mode of curing. And thus there are six chapters on curing inward diseases.

12. In curing feverish diseases (where heat prevails) in general, there are the following distinctions : cause and incident, nature, symptom, mode of curing.

13, 14. Further explanations on the causes of the heat and cold, in fever.

15. In the curing of a fever, in its beginning, or where heat has not yet taken the upper hand, there are enumerated the following distinctions : cause and incident, nature, name, division, symptom, mode of curing.

16. In an increased or burning fever, the same distinctions are as before, except a trifling division.

17 to 20. On curing several kinds of fever, such as are : the sly, hidden, inveterate, and the mixed ones.

21. The curing of inflammation of any hurt or wounded part of the body, with several distinctions; and that of inward and outward hurt : the inwards are, the viscera and the vessels; the outward parts are, the flesh, bone, marrow, tendon and fibre.

22. The curing of heat or fever (arising from the contest between wind, bile, and phlegm), in which the mental faculties are troubled, with several distinctions to be considered; and so there are 11 chapters on curing fever (heat and inflammation).

23. On curing epidemic maladies or infectious diseases, with several distinctions and divisions ; as, a kind of pestilence of Nepal.

24. On curing the small-pox : cause and effect, definition of small-pox, distinction, symptom, mode of curing; distinction into white and black variolae, each having three species.

25. The curing of infectious diseases affecting the bowels (colic), with several distinctions; purging the viscera and the lower vessels, affecting with greater or less vehemence; and so there are eight kinds of diseases affecting the bowels.

26. The curing of swellings in the throat (or of ulcers and inflammations), and infective diseases, as the cholera : the first has 4, the second 11 subdivisions, or minor distinctions.

27. With respect to catarrh, are considered : cause and incident, kind, symptom, mode of curing. And so are five chapters on infectious diseases, to which belongs the cholera morbus also.

28. In curing the upper part of the body, the head occupies the first place. Here are considered : cause, circumstantial accident, distinction, symptom, mode of curing. There are

eight distinctions, as wind, etc.

29. In curing the diseases of the eyes, are considered : cause, incident, division, symptom, mode of curing, with 33 distinctions of opthalmic diseases.

30. Diseases of the ear; cause and incident, or accessory cause and effect, division or distinction, symptom, mode of curing. Distinction into disease of the ear, and deafness; that has six, this four, kinds.

31. Diseases of the nose : cause and incident, division, symptom, mode of curing; there are five divisions or distinctions.

32. In the curing of the diseases of the mouth, there are to be considered : cause and incidents, division, symptom, mode of curing. There is a six-fold division; as, the lip, the gum, etc. There are several distinctions of diseases, as six of the teeth; five of the tongue; six of the palate, and seven of the throat.

33. In curing the diseases of goitre or swelling in the forepart of the neck, are considered : cause and incident (or accessory causes), distinction, symptom, cure or remedy. There are eight sorts of goitre, as those arising from wind, bile, etc. Thus six chapters are on curing diseases in the upper part of the body.

Now follows the curing of diseases affecting the viscera, and the entrails or vessels.

34. In curing the diseases of the heart, there is treated of : cause and incident, division, symptom, and remedy. There are seven distinctions of diseases in the heart; as the throbbing or palpitation of the heart etc.

35. In curing the diseases of the lungs are considered : cause, division, symptom, remedy. There are eight distinctions of diseases.

36. In curing the diseases of the liver, are treated of : cause, division, symptom, remedy. There are 18 distinctions of diseases.

37. In curing the diseases of the spleen or milt, four things come into consideration. There are five kinds of diseases, as

inflammation, etc.

38. In curing the diseases of the reins or kidneys, there are four considerations, with seven kinds of diseases; as wind in the reins, etc.

39. In curing the diseases of the stomach, or the pit of the stomach, there are likewise four things to be previously considered. And first, 16 kinds of diseases, as heat, cold, etc. and again five kinds, as wind, etc.

40. In curing the diseases of the intestines or bowels are considered four things, as cause, etc. with the distinction of five kinds of diseases.

41. In the curing of the gut of the entrails or bowels, are considered : symptom and remedy, with five distinctions of diseases; as cold, puffing up, etc. Thus eight chapters are on curing the diseases of the viscera and vessels.

Diseases of the privy parts.

42, 43. In these two chapters for male and female cases are considered: cause, etc. four, with nine and five distinctions of disease respectively.

This class of disorders is called secret disease.

The curing of little diseases.

44. In the curing of hoarseness, or difficulty of using the voice, are considered: cause, incident, etc. four, with seven distinctions of diseases; as wind, etc.

45. In curing aversion from food, or restoring the loss of appetite there are considered: cause, etc. four; with four distinctions of that disease.

46. In curing the distemper of continual thirst, are considered: cause and incident, etc. four, with five kinds of that distemper; as wind, bile, etc.

47. In the curing of the hiccup, the disease of convulsion of the stomach, are considered : cause and accident, etc. four, with five distinctions of that distemper; as from meat or food, etc.

48. The curing of the difficulty of breathing : cause, etc.

four; with five minor distinctions.

49. The curing of a sudden cholic, a distemper of the bowels, are considered : cause and accident, etc. four; with three principal, and eleven minor kinds of that distemper; besides some others that are enumerated, as heat and cold; worms and phlegm, etc.

50. The curing of diseases arising from worms (in the belly or bowels) : and insects, are considered : cause and accidents, etc. four, with two distinctions inward and outward worms or insects; as belly worms, lice, and nits.

51. In curing vomiting, are considered : cause and accidents, etc. four, with four distinctions of that distemper, as wind, etc.

52. In curing purging diseases (or dysentery), are considered : cause, etc. four, with four distinctions of that distemper, etc.

53. The curing of obstruction of stools, or of evacuation, four things to be considered, and five kinds of that distemper are enumerated.

54. In curing dysury (or difficulty of making urine), is treated of the cause and accidents, etc. four, with several distinctions of the kinds of that distemper.

55. In curing the frequent discharge of urine; cause, etc. four, with the three kinds of that distemper, arising from phlegm has again 10 distinctions.

56. In curing the disease called the "Indian heat" (very dangerous to Tibetans, by causing excessive heat and frequent evacuations, of which many die who visit India), are considered : cause, etc. four, with four distinct divisions of that distemper.

57. In curing the swelling or enlargement of the feet, are considered : cause, etc. four, with four distinctions of that disease.

58. In curing the gout are considered : cause, etc. four, with six distinctions of that painful distemper.

59. In the curing of diseases arising from the serum or watery parts of the blood (yellow water, bad or corrupt

humours), are considered : the manner of its origin, its division, symptom, mode of curing, with several distinctions.

60. The curing of the disease called "the white vein," with several divisions and distinctions.

61. The curing of cutaneous diseases. Of these there are several divisions and distinctions.

62. The curing of miscellaneous diseases of the smaller kind : such as contraction or sinking of the sinews; dysentery; vomiting; any hurt caused by fire; hurt or wound made with a needle; or when a needle or the iron-point of an arrow happen to be swallowed; choaking or suffocation; on the stopping of any thing in the throat, as, a beard of corn, bone, fish-prickle; the entering or swallowing in of a spider or scorpion; intoxication; stiffness of the neck; ill smell of the body; hurt of the hands and feet caused by cold and snow; the creeping of any insect into the ear; the swelling of the teat of a woman. The curing of all such diseases is called the cure of small diseases. Thus there are 19 chapters on minute diseases.

The healing of wounds, sores, or ulcers.

63. The curing of ulcers here are considered : cause, etc. four, with several distinctions.

64. The curing of the hemorrhoids (piles or emerods in the fundament) : cause, etc. four, with six distinctions.

65. The curing of St. Anthony's fire (any swelling full of heat and redness) : cause, etc. four, with several distinctions, and the places (or parts) where generally they occur.

66. The curing of the Sūrya disease affecting the lungs, liver, etc. its beginning, etc. four, with some distinctions.

67. The curing of cancerous or virulent bad sores or ulcers : cause, etc. four, with eight distinctions.

68. The curing of the swelling of the testicles : cause, etc. four, with six distinctions.

69. The curing of a disease in the foot and thigh, called rKaṅ-bam or enlarging and corruption of the feet, etc. a painful disease in the bones accompanied with inflammation, and blue colour of the skin : cause, etc. four, with several distinctions.

70. The curing of the ulceration in the perineum : cause, etc. four, with some distinctions.

71. The curing of diseases incident to infant children, with the description of several surperstitious customs or practices which are performed at the birth of a child, as examination of the time at which it was born, whether it is lucky or unlucky; imparting of the benediction; the cutting of the umbilical cord; the making it live long; the making it suck, the time, etc. etc.

72. The enumeration of several diseases common to infants and children : cause, etc. four, and the mode of curing them.

73. The curing of diseases caused by any (supposed) evil spirit, 12 kinds of such diseases : symptoms and remedy.

Thus three chapters are devoted to the diseases of infant children.

Then follow, on curing the diseases of the female sex. These distempers are thus distinguished : general, peculiar, and vulgar or common.

74. On curing the diseases of the female sex, in general, are considered : cause, etc. four, with two distinctions originating in the blood and wind.

75. The curing of the particular diseases of woman : cause, etc. four, with many distinctions; as with respect to the several humours, of which they arise.

76. The curing of the common or vulgar diseases of women, with the circumstances of child-birth.

On curing diseases caused by evil spirits.

77. The curing of diseases caused by a ghost (or evil spirit), of which there are 18 kinds enumerated, from among the Sura-s and Asura-s. Here are considered : cause and incident, division, symptom, and remedy.

78. The curing of insanity or madness : cause, etc. four, with seven distinctions, as it is caused by wind, bile, etc.

79. The curing of a kind of insanity called "forgetfulness" (lunacy ?) : enumeration of its several kinds, the symptoms, and the remedies.

80. The curing of palsical diseases, and the telling of the periodical time of their occurence, the symptoms, and the

remedies for preventing their recourse.

81. On the curing of diseases, in which the body is infested with cancerous ulcers, is eaten away and dissolved : considered cause, etc. nine, with 18 distinctions respecting its different kinds, and the places (or parts) which are generally affected.

The above five chapters are on such diseases as are supposed to be caused by the influence of some malignant demon.

82. On the curing or healing, in general, of wounds, made by any kind of weapon or tool. Here into consideration come; 1, cause; 2, accessory cause or incident; 3, nature (of wound); 4, definition or description (of the wound); 5, its name; 6, place; 7, division; 8, symptom, mode of curing or remedy, excision or cutting out, cicatrizing.

83. The curing of wounds on the head, here are considered : the manner of its being, examination of the injured part, manner of curing, recovering, or being overpowered.

84. The curing of wounds on the neck or throat, where the bone, vein, or nerve, and the tendon or sinew come into consideration.

85. The curing of wounds on the upper and lower parts of the thumb of the body; manner or that of being; symptom, remedy, healing.

86. The curing of wounds on the hanging members (arms and legs), the knowing, the importance or consequence of, etc. symptoms in general, mode of curing, or restoration.

Thus four chapters were on curing wounds; henceforth the curing of poison, or remedies against poisoning.

87. The curing of injuries caused by artificial or prepared poison. Here are considered; the kind of poison, entrance or infection; quality, the manner of its spreading or prevalence; remedies employed, final cessation or remains.

88. The curing of simple poison, and of poison in the flesh. With respect to the first : cause, symptom, remedy; in the second case, two points more come in consideration.

89. The curing of real or material poison. Two cases : 1, spreading; and 2, not spreading.

These three chapters were on curing injuries caused

by poison.

90. On curing the weakness of old age, or procuring strength to weak, old men. Emoluments, place, recourse to, remedy.

91, 92. On the means of increasing the power of vigour in men.

Here ends the summary extract of the 92 chapters, on the instruction of curing diseases.

FOURTH PART

Which contains the explanation of the practical part of Medicine. [Containing the following chapters]:

1. The examination of the pulse, wherein 13 cases are enumerated on the character of the distemper.

2. The inspection of urine, wherein, as it is said, the vicious state of the whole body may be seen, as in a mirror.

Thus two chapters are on examining the pulse and urine.

Afterwards, when the character and name of the disease has been found out, what sorts of medicaments are to be administered, is exposed.

3. First liquid medicines, of which there are 54 for curing inward heat, and 23 for assuaging cold fits or ague. Together there are 77 sorts of liquid medicine.

4. Enumeration of powdered medicine, or medicaments in powder, of which the mixture is stated to amount to 96, for assuaging the heat of any distemper; and 69 against cold fits. Both together=165. When they afford no relief, there is taught of another remedy.

5. Physic or medicaments in pills, of which the different kinds of mixture amount to 22.

6. The several kinds of syrup (a kind of mixture) are described or taught, of which 15 are for assuaging heat, and 5 against cold fits. Both together=20.

For procuring strength to the body, and for drawing out an inveterate disease.

7. Is taught of a mixture, called medicinal butter consist-

ing of several ingredients, of which there are 14 sorts for curing heat, and nine for taking away cold fits. Both together=23.

8. 13 kinds of mixture of calcined powder, for curing an ague caused by a too much abundance of phlegm.

9. 17 kinds of mixture or syrup, especially for the purpose of assuaging heat.

10. 19 species of mixture of medicinal wine (or *spirituous* beverage), are enumerated, for curing diseases, in which wind prevails.

11. A mixture, as a remedy against any inveterate malady whatever, prepared of precious stones, for curing the diseases of princes, and of opulent men. One against heat, and 11 against cold; eight against both; together=20.

Since men, in general, cannot have precious stones required for such a mixture for curing diseases, in the

12. Is taught of such vegetables or plants that are procurable by all, of which the several mixtures amount to 28 for curing heat; and 14 for assuaging cold fit.

Thus taking together all assuaging remedies from the liquid to the vegetable medicines, there are 418. So much of the assuaging remedies. When they are insufficient, in the

13. Is taught of purging or depuratory medicines in general.

14. Of purging medicines operating downwards, for carry-away corrupt blood, bile, and the relics of other diseases. There are three kinds of such purging (or depuratory), medicines, operating : gently, moderately and strongly; of which all there are 82 species.

15. For carrying upwards or ejecting the remains of such diseases, as belong to the phlegmatical kind : here vomits are prescribed, of which there are eight of the stronger, and eight of the gentle kind, both=16.

16. A composition of medicine, for cleansing or purging the nose, five of the gentle, and two of the strong kind.

17. Elixirs or extracted juices, for drawing downwards the diseases in the entrails or intestines and guts.

18. The same continued and specied.

19. Elixirs or mixtures for cleansing the veins (or depura-

tory elixirs for *do*). Thus seven chapters are on depuratory medicines.

If by the above means there is no sufficient relief, in another sūtra is taught of other soft and hard remedies.

20. How to let blood in such distempers, when heat prevails. There are counted 77 veins, of which any may be opened for letting out blood.

21. The application of a caustic for curing diseases, when cold, or cold fits prevail.

22. The use of a venomous mixture.

23. On the use of medical bath, for diseased members.

24. On adhibiting medicinal unguents.

25. On medicines operating downwards.

26. The conclusion. Though there be many ways (1,200) of examining the heat and cold prevailing in any disease, they all may be reduced to the following : to look on the tongue and urine, to feel the pulse, and to ask (after the circumstances of the beginning and progress of the disease in question).

Thus the remedies adhibited against diseases, though they be counted many (1, 200) yet they may be reduced to the following four classes : medicament, manual operation, diet, and exercise. Medicament is either assuaging or depuratory; the manual operation is either gentle or rough; food is either useful or noxious; the exercise is either violent or gentle.

Again : though there be numbered 360 practical modes of curing diseases, they may be reduced to these three : examination of the patient (or of the symptoms of the disease). Rules for curing such and such disease. And the manner in which the remedy is applied.

There is taught also of preservatives for a physician, to keep himself safe from any malignant infection from a patient.

27. Recommendation of this treatise to the care of the audience, by the teacher, Śākya. Classification and moral application of the above enumerated 404 diseases.

The volume concludes with an account of the mode in which this treatise on medicine (consisting of four parts) reached Tibet, which is briefly incorporated in the introductory remarks

SANTAL MEDICINE

P. O. BODDING

I

In the paper called *The Santals and Disease*,[1] the general ideas of the Santals as regards the nature and causation of disease, their superstitions, and their general attitude in connection with disease and death have been stated. The doings of their medicine men and *ojhā*-s have also been told, samples of their *mantar*-s and invocations have been given, and so on. For all such matters the reader is referred to the paper mentioned. Practically nothing has been mentioned in that paper concerning what corresponds to what we understand by medicine. This will be given here in the following pages. Before entering on details some remarks may be called for, as regards the origin of this work and as regards certain sides of the Santal way of practising medicine, and other matters that have not found a place elsewhere.

The writer's interest in the matters here treated of is of a double nature, partly and principally ethnological, and partly 'medicinal'. It should, however, be added that the writer is not a medical man, perhaps the very reason why he has taken up a work like the present one, and he hopes, it will be found that he has nowhere attempted to intrude into the domain of the profession.

To know how an uncivilized people tries to face and fight disease and everything connected therewith, is to know how they try to tackle, or evade tackling, some of life's great problems. Facing disease man often reveals what is otherwise only seldom seen.

1. This forms the first chapter of P.O. Bodding's *Studies in Santal Medicine and connected Folklore* (Memoirs of the Asiatic Society of Bengal, vol. X, pp. 1-44)—Ed.

As regards their medical practice, the attitude of the Santals may be summed up as being, according to their lights, practical treatment, combined with superstition, resulting in, sometimes, a quite sensible attitude, and sometimes in absurd attempts to gain the victory over the enemy.

Knowledge of their medicine will, within certain limits, show their knowledge of nature, and how they use this knowledge.

It is also of some interest to know what disease a people like the Santals has, or knows of, and to ascertain their amount of knowledge in this respect. In this respect I have had assistance from properly qualified doctors (from Mrs. Bödding, M.B. & Ch. B. [Edin.] and, at one time, from Dr. B. B. Bogh).

There is just a possibility that in the very large heap of medicinal ingredients made use of by the Santals there may be one or two, the qualities of which it might be advantageous to find out and to test.

When the writer in January, 1890 came out to the Santals, he was from the very first brought into contact with their medicine. It did not take long to be made aware of the Santals having medical treatment and medicines of their own, and of their belief in this. They might doubt the efficacy of certain medicines; but many were affirmed to be 'proved,' as they called it.

It was not seldom to hear them profess to be able to cure what European doctors consider hopeless. In some cases (not hopeless ones) that came to the writer's notice it also seemed to be a fact that they had applied remedies of an efficacious nature.

This possibility that something of value might be found, in connection with ethnological curiosity, made me commence taking down 'prescriptions' of theirs that I happened to come across. I think the first I ever wrote down was one of their remedies for rabies. One of our workers had a large scar at pit of the stomach. Being asked how he had got this, he told he had once been badly bitten by a mad dog. His grandfather had given him some medicine, and nothing had happened to

him, whilst others that had been bitten by the same dog and had got no medicine, all died. Then came a remedy for gravel, another for dysentery, and so on, to be followed by 'medicines' to prevent a wife from running away, and remedies of a similar nature. As will be understood, I got from the very first into the middle of it and was met with examples of what might be sensible, and with examples of rank humbug and supersitition.

There is scarcely a grown up Santal man who has not some knowledge of the kind of medicine treated of here, as is only natural considering the lack of real professional help amongst the people; every one has to rely to some extent on himself. One man knows, e.g., a remedy for cough, another for diarrhoea, a third for snake bite, and so on. It is 'reported' to have helped some; then why not others? Some are regular specialists in the treatment of, e.g., tuberculosis or venereal disease, charging specialists' fees. Some persons may have established quite a reputation and are sought by patients from far away.

It might also be mentioned that the Santal young men are supposed to go through a kind of course in *mantar*-s and medicine among other matters. This has been fully described in the paper entitled *The Santals and Disease.*

Some know remedies for several diseases, and a few have taken up seriously 'medicine' as a profession and are all round medicine-men who try to, or profess, to cure all diseases and ills not caused by supernatural agencies, i.e., by *boṅgā* (evil spirits of sorts) or by witches.

It should be mentioned, that there are very few Santals, if any at all, who have 'medicine' for their only means of subsistence. For most it is a mode of earning just a little outside the ordinary, a means of getting good food and a drink now and then. For some few it may mean a good income in addition to their agricultural earnings.

It is generally only men who practise. Women may sometimes be round assisting their husbands when they give certain medicines, e.g. to females. A practising woman would undoubtedly be suspected of being something more than a 'doctor', she would be taken to be a witch very likely. It may, however,

happen that a woman 'knows' some remedy or other and may make use of such knowledge. I have heard of a very few women practising, all considered 'doubtful', but also clever 'doctors'.

As mentioned above, the writer commenced taking down 'prescriptions' and other matters connected with Santal medicine some thirty-four years ago, and continued doing so occasionally, so long as people were found who could be 'tapped'. How many such sources there have been, it might be difficult to say. I shall mention a few of my sources as examples.

At Mohulpahari where the writer has spent most of his time in India and has his home, a Santal, living in the village of the same name was regularly practising. He was one of the most sensible of his class that I have come across. His remedies were all herbs, roots, barks and fruits of sorts, never a large conglomeration of all kinds of stuff (some of them next to impossible to procure, a method offering an easy expedient, although perhaps not often resorted to, of putting the blame for failure on the absence of some of the stuff enumerated). I also saw this man setting a fractured bone very nicely and doing other things which one would not think an uncivilized Santal capable of, and which they, for the matter of that, also generally are unable to do properly.

I prevailed upon this man to sell me his knowledge. He came when he 'remembered' something, and some three scores of the 'prescriptions' recorded are due to him. He made me promise, that so long as he lived I should not divulge his mode of treatment or any of his secrets to any one here in these parts, in order not to give him competitors and deprive him of certain means of income. He is dead now many years ago. This man did not believe in *ojhāism*, but I have been told that in order not to lose his practice, and to please his patients he had to affect appeasing the *boṅgā*-s by offering sacrifices to them, a significant feature both as regards himself and as regards his patients.

Another Santal from whom I have got a large number of 'prescriptions' is one of our mission-workers now in the Dinajpur

district. He had been practising both in this district and in Dinajpur long before he became a Christian, and has continued, although perhaps not to such an extent as formerly. Having heard of his reputation I asked him to write down his knowledge. Not being much of a calligrapher himself he dictated what he had to tell to a schoolmaster. In many cases he has given also some of the symptoms of the diseases. He apparently has a very strong belief in the efficacy of his medicines. This man is the most 'learned' Santal 'physician' I have come across. He has collected 'prescriptions' from all sides, according to his lights not uncritically, as I have understood him to know of much that he has not put down, because he did not believe in it. Most he has got from other Santals, a few he must have got fram Bengali sources.

A third 'authority' who might be mentioned is now an old man who has been with the writer for more than thirty years, as a literary helper and ethnological collector. When he heard about this matter being looked into he became quite excited and forthwith commenced to go round collecting stuff from all he could get hold of. Many 'remedies', the essential part of which is based on superstition and belief in magic, have been collected by him.

Other people showed a similar interest, when they heard about the prospect of something being published on their own medicine. Several persons came and offered their 'knowledge', sometimes for a consideration, but just as often out of interest in the fact that their own medicines were to be brought to the knowledge of others. The large number of contributors made it possible to follow several of these remedies to some common source. There may also be some common forms of treatment, presupposing a kind of 'school' if such an expression is permitted.

I have to thank my old friend and colleague, the late Mr. H.I. Muston, for having relieved me of the drudgery of transcribing and translating most of the Santali original manuscripts. Wherever possible it has been thought to be of interest to have a literal translation. When there seems to be no doubt on

the subject, our names of diseases have been given.

I am sorry I have not been able to get the botanical names of all the plants used in Santal medicine, and I am not quite certain as to the correctness of all the botanical names given. The Santali names are there, and if any one should wish to investigate the nature of the stuffs used it will always be possible to procure the genuine article itself. I have, as to botanical names, drawn freely on Dr. Campbell's dictionary.

It would have been easy to cut the whole down so as to leave only the botanical ingredients of the different 'prescriptions'. Doing this would, however, have made the present work serve only one of the purposes for which it is written, and that not the essential one, viz., to be of some possible service to medicine. When so much more has been recorded and a literal translation has been given, the great ethnological interest attached to the subject must serve as an explanation and excuse.

II

As to the original sources of these 'prescriptions' it is difficult to say anything with certainty; it seems that the bulk of them is indigenous. The ingredients are mostly what is to be found in the forests of the Santal country; the names are mostly Santal ones.

So far as I remember only two are of clear European origin, that of Cod-liver-oil for night-blindness, quite recently received through missionaries, and carbolic acid used against syphilis. This last one they have very likely received from some compounder or other. The use of hot tea for dysuria and constipation is likely a 'discovery' of their own.

A few are easily traced to Indian *bāzār* medicine, viz., those that for ingredients have stuffs bought in the *bāzār*-s, all having Bengali or Hindi names.

Some may possibly have originally come from one of the Hindu systems of medicine. Those who have studied these will be able to tell whether this is so or not. I have understood

that some Santal *ojhā*-s have learnt from non-Santal *ojhā*-s, from some belonging to the *kāmār* (blacksmith), *ḍom* and other castes, also (very rarely) from Pahariās and even Jolhās. All this will, however, amount to very little.

It may in this connection not be out of the way to mention, that the traditions of the Santals state, that their ancestors have learnt *ojhā* 'science' from *Kāmru-guru*, undoubtedly a non-Santal, very likely a Hindu. With regard to this person the reader is referred to the paper *The Santals and Disease*. One gets, however, the impression that what the Santal *ojhā* has learnt from *Kāmru-guru*, whoever he may be, is not so much medicine as magic, *mantar*-s, charms, etc., with which to subdue or drive away the supposed malevolent spirits.

Kāmru-guru has in any case been a teacher of more than medicine. It might be remarked, that his followers, the *ojhā*-s of the present day, base their reputation as 'doctors' just as much, or perhaps even more, on their supposed ability to deal with the supernatural powers, as on their knowledge of medicine.

The *ojhā*-s guard their professional secrets with great jealousy.

Whatever there may be of foreign origin, the medicines are now generally 'Santalized'.

There are no invocations or *mantar*-s connected with the collection and preparation of the medicines. The only thing of a similar nature is the *ran jagao*, the 'awakening' or blessing of medicine, at the time of the Santal *Dasae-porob* when the year's course in *ojhā* 'science' is finished (see paper *The Santals and Disease*, where all this has been described); this does not, however, refer to any special ingredient, but to the effectiveness of medicine in general. There are, as will be seen, certain instructions given as to time and mode of collection of certain ingredients; but this is all, so far as I have noticed, and the medicine-men deny the use of invocations. This does not, as is mentioned elsewhere, exclude that *mantar*-s and invocations, partly combined with sacrifices or sacrificial acts or promises of such, are resorted to by the *ojhā* and the patient's relatives.

This is part of the *ojhā*'s business. All this does not, however, seem to have anything to do with the application of the remedies as such. It is resorted to, not to make the stuff itself efficacious, but as a safeguard, by excluding or preventing the influence of malevolent spirits. The *mantar*-s muttered when using the oil-oracle, also the 'reading' over oil, salt and such things, might be mentioned; but it is not the efficacy of the remedies that is the primary object.

As to the age of the 'prescriptions' here recorded it is with our present knowledge not possible to say anything. Some of the remedies are of quite recent date, others may be followed back for some generations. They are also very likely adapted to time and locality 'improved' or otherwise.

How they have got some of their remedies a couple of examples will show.

The writer had many years ago a dog famed for his exploits as a snake-killer. Once during my absence from home this dog was badly bitten by a poisonous snake. His neck, I was afterwards told, swelled up to a large size and all were sure the dog would succumb. Then the dog was seen to go to a place in the compound and there ate some herb or other, whereupon he recovered. A servant had followed the dog and saw what he did. He and the others were sure the dog had shown an infallible remedy for snake-bite.

Santals are reported to have watched the common lizard or the mongoose and to have seen what these have used for sting of scorpions and scolopenders and for snake-bite. During such encounters lizards and mongooses, it is told, have been seen to eat certain plants or the bark of certain trees, and also to rub themselves against the same trees or plants.

I have heard a story of a couple of men watching an old *hanumān* monkey treating and curing a couple of young monkeys bitten by a cobra. The old *hanumān* was acting like a regular doctor, feeling the hands, i.e., the pulse, of the patients. Having in this way ascertained what was the matter, he had bitten off the bark of a certain tree, had chewed this, and spitting it into their mouth he had made them eat this whilst he also applied

some of the same stuff on the spot bitten. The young monkeys recovered very quickly, whilst before treatment they had been very low.

Now this story is a rather tall one and likely invented to make people believe. But even so, such stories show that the Santals believe in and are not unwilling to make use of the animal instinct. It should, however, be added that all stories of this kind that I have heard are restricted to the class mentioned, to find an antidote against poison, as is quite natural.

Another remedy was got in the following way : One night a man dreamt that a dead relative of his came and told him about an infallible medicine for *puni*, atrophy in babes. The remedy was the egg of the humming bird, to be eaten. This is just mentioned because it may be of some psychological interest.

In this connection it may be noted that the Santals have also a belief that a disease may be either caused or cured by some stuff, the name of which sounds similar to the name of a disease, or the shape of which may in some way remind one of some of the symptoms.

They say that eating *mandargom (Anona squamosa)* will cause *manda*, a cold. They do not, however, seem to heed this much; they are fond of *mandargom.*

The roots of a shrub they call *pet cambra (Helicteres isora)*, the fruit of which has a peculiar twisted shape, is believed to be a remedy for colic.

Among the ingredients used for small-pox are the conical prickles of Simol tree *(Bombax malabaricum,* DC.) and the 'warts' found on the leaves of the *Ficus glomerata* (Roxb), both likely reminding a Santal of the small-pox eruptions.

The remedies just mentioned may be classified as belonging to what is called homoeopathic magic. They have a fair number of these, especially for the many kinds of what is called *bai*, convulsions, cramps, an involuntary state or movement of the body, or any part of the body, over which one has no

control. They distinguish a large number of *bai* according to the symptoms.

For what is called *haṭman bai*, monkey cramp, one remedy is to get the head of a monkey and rub this against a stone and smear on the stuff thus procured.

For *harna bai*, deer cramp, so called because the patient is in trepidation, grinds the teeth and moves the upper lip like a deer when eating, a deer's horn is rubbed against a stone; part is smeared on his forehead, and the patient is to lick it.

For icterus one remedy is as follows : A bit of the bark of the mango tree with a little lime smeared on is given to the patient who is to stand turned towards the sun, when it is rising, with the bark in his hand. The medicine-man then takes a cup of water and pours the water on the patient's hand, whilst somebody else rubs him. In this way all yellowness is supposed to be washed away.

For what is called *jnapni bai*, when the patient is unable to open his eyes, as in coma, they use a remedy consisting of a small plant called *jhapni* by them (the leaves close up at night), and the 'eye' of a peacock's feather; these are ground together, plastered over the whole body, and also licked.

For what is called *kandon bai*, continual crying, especially in children, they use the dirt from a cart axle; the more the cart was squeaking the better; the dirt from a *carkhi*, a machine used to separate the seeds from the cotton, also squeaking, has the same effect...

The last one mentioned treats of what is called *suar bai*, pig cramp; the patient foams at the mouth like a pig; he makes a sound like a pig smacking when eating. Here one ingredient is the jaw-bone or the skull of a pig, to be ground together with certain other stuffs, part to be plastered all over the body, parts to be eaten. It is 'prescribed' that the pig whose bones are to be used should have been killed by a tiger or leopard. If such is not available the bones of a healthy pig may be substituted. That the bones of a pig killed by a tiger should be more efficacious than those of a pig killed in an ordinary manner touches another Santal belief, that qualities in an agent

may be passed on to what has been acted on; in a similar way an implement used with success may be supposed to get special inherent qualities. We shall not follow up these superstitions here; traces are found elsewhere among the Santal remedies.

A couple of other examples of the above mentioned superstition may be referred to.

In diseases in which blood is seen, something of a red colour may be found among some of the remedies. Thus for spitting of blood in phthisis the red *Nymphaea rubra* is used, also a bit of a red woollen blanket (preferably of European make). In menorrhagia similar red-coloured ingredients are applied.

For male impotency one of the ingredients is a male sparrow to be eaten together with certain other stuffs. The sparrow is by the Santals considered to be especially strong in what is here desired, so much so, that 'like a sparrow' may be heard used as an opprobrium.

The remedies resorted to in supposed female barrenness might also be mentioned. Among the stuffs used is the dried umbilical cord, some midwife will secure a bit of this, dry it and keep it to be able to give to barren women.

One of the remedies for *aha*, vomitting with diarrhoea, especially in children believed due to the evil eye, also belongs here. One is to take the kernel or stone of the fruit of *Spondias mangifera* (Pers), that has been sucked and thrown away; this is to be ground and given to be drunk in water.

For *taru landup*, perforating ulcer of the palate, one remedy consists of a hare excrement, hare's hair, and the stomach or quills of a porcupine. Likely the peculiar movement observed in the nose of the hare has been the origin of this remedy.

To cause mother's milk to dry up, a little milk is buried in a plough-furrow.

For a suppurating breast earth heaped in front of a plough when ploughing is moistened with water and applied.

A number of other 'homoeopathic' remedies may be found.

To sum up : As regards the origin of the great bulk of the medicines practically nothing is known; but one may be justified in supposing that what has been the case with others has

also happened with the Santals. They have hit upon something in some way or other and may have thought it efficacious; they may then have tried the same for other complaints than the one it was originally used for, have found it useless or possible, and have in this way been guided by experience according to their lights.

Sometimes one wonders whether people like the Santals have not more of the primitive instinct left than we have. Certain phenomena of a psychological nature might seem to point this way (so to say 'standard' dream of theirs are curious, e.g., about coming rain). Any number of vegetable poisons may be found in their forests, but it is very seldom indeed that one hears of a Santal having suffered by mistaking these for something else. To mention a concrete example of something similar : the Santals are very fond of eating some of the edible mushrooms. As is well-known, some of the poisonous mushrooms may look very similar to certain edible ones. In Europe mistakes are sometimes heard of; among the Santals they are very seldom indeed. The writer has never heard of such cases; but as they have medicines to be used in such cases, they must be happening.

III

As may be expected, the diagnosis of disease is a great difficulty with them, as soon as they are confronted with anything different from the common diseases of everyday occurrence.

There are few grown up Santals who have not killed or assisted in killing animals and cutting them to pieces; they have also frequent occasion to see something, e.g., when a dead body is burnt, although their natural feelings will keep them at some distance; they consequently must have some vague or general idea of the anatomy of their own bodies. They might be thought to get some assistance from this, but apparently do not get much. Bearing in mind how observant of details a Santal generally is, it is strange that they do not

know more of their own bodies and the nature of their ills than they seem to do. Likely their supersititious fears that disease is frequently due to the malevolent influence of evil sp'rits may have something to do with this.

In this connection attention might be drawn to their names for diseases. Most of these are symptomatic, as will be observed. Exceptions are names borrowed from other races, however, also often symptomatic, and the names of a few diseases of a well-known and easily recognized character, or of diseases attributed to some specific action of the spirits or the witches. The name is generally taken from some easily recognized, striking symptom observed. But as several diseases have symptoms in common the same name may be used for different diseases. On the other hand some diseases will show different symptoms at their different stages of development. The same disease may therefore be known by several names.

A few examples will show the position. Take tuberculosis of the lungs. As may be expected, they do not recognize the nature of the disease in its first stages. It is then called cough of some sort, generally getting a name according to the peculiar sound of the coughing or the amount of phlegm expectorated. In its more advanced stages it is mostly called *dhok*; this name is also used for some form of bronchitis. As soon as haemoptysis sets in, all other names are discarded, and it is called *rāj rog*, the king-disease, that is, not the disease of kings, but the sovereign disease. I have an impression that the ordinary Santal often thinks that an entirely new disease has taken possession of the patient, when the spitting of blood commences. Tuberculosis in other parts of the body than in the lungs is naturally not recognized as such.

Or take syphilis. To start with, any venereal disease may be called *gurmi*, a name meaning heat and also used for some other quite different ailment. During the later stages when sores break out, these sores have different names according to site and appearance, and are generally considered to be due to different diseases.

A disease like cholera has many names. Their regular name

for this is *hawa duk,* lit. air affliction,[2] a name that points to the supposed origin or spreading of the disease. The most common name is, however, *maran lac odok,* the great stomach outcoming, any abnormal evacuation being called *lac odok,* stomach outcoming. Another name is *arhata,* lit. two and a half, viz., *pohor,* periods of four hours each, 'the ten hours'. This name refers to the rapid course of fatal cholera.

Murhuc jom, leprosy, is often called *maran rog,* the great disease. *Guti,* small-pox, is frequently referred to as *latu kasra,* large scabies.

The use of names like these last ones is due to a peculiarity of the Santals : they do not like to name a thing by its proper name, especially if it is something of a serious nature or something to be feared. To be bitten by a snake is thus generally referred to as being 'hurt by a twig.'

IV

The work here published will give some idea as to the occurrence of disease among the Santals. They have at the present day generally speaking the same diseases as are found in the tropics among other races. They tell that they did not have syphilis, tuberculosis and leprosy until after the Santal rebellion, really an attempt to rid themselves of the foreign money-lender, in 1855. This is very probably a too sweeping statement; but this rebellion marks the end of an epoch in the life of the Santal people. Up to that time they were living much more by themselves, in the forests, fairly unexposed to infection from other races and leading so strenuous a life that likely only the strongest survived, persons who had the power of resistance. In any case the state is now quite different.

2. It might be noted that the name used by the Santals for an epidemic is *disom duk.* This may be literally translated 'country affliction' or 'grief'. *Duk* means affliction, sorrow, grief. *Duk* alone is often used for separate instances of death, through a fatal disease or otherwise. *Disom duk* is used for what we call an epidemie, provided it is something with a high mortality. Their point of view is the way in which the whole land is affected.

Venereal disease is fairly common, although not at all to such an extent as it is reported to be found among the surrounding Bengalis and Biharis from whom they have likely acquired the contagion. Tuberculosis is becoming fearfully prevalent among them, in spite of their out-door life. Their lack of understanding the nature and the infectiousness of this disease make them careless. When the disease has entered a family it generally reaps a fearful harvest. Leprosy was not common among the Santals formerly; during the last generation it has become alarmingly so.

My wife who is a qualified doctor tells me that in her experience malaria is, as to prevalence, far ahead of all other diseases, also among the Santals. Next come skin diseases, such as scabies, eczema, ringworm, etc, and then bowel complaints. Dysentery is very common and often fatal.

Eye diseases are very frequent, and many have lost their sight through sheer ignorance and want of timely treatment. It might be noted that the Santals generally have splendid eyesight; cataract is very common and often seems to afflict people at an earlier age than is usual in our countries.

Pneumonia and pleurisy are of much frequent occurrence than one would expect in a hot climate; the same may be said of rheumatic complaints; their exposed life and carelessness as to exposure explains this.

Tumours, malignant or otherwise, are not rare. Some of the horrible diseases caused by Filaria, so commonly met with in other parts of India, and also fairly frequently seen amongst Hindus living in the same country, are very rare among the Santals.

As a curiosity it may be mentioned that I have not heard that appendicitis has been met with among the Santals, only one suspected case has come to notice.

Among the so-called infectious diseases common in Europe most occur also among the Santals, with a couple of exceptions. Scarlet fever I have never heard of among them, and so far as I have been able to find out diphtheria is practically unknown.

Among epidemic diseases the Santals recognize four or five,

viz., cholera, small-pox, measles, plague and chicken-pox. As regards the plague (with a borrowed name called *mahā-mārī)* they have fortunately not had it among themselves and consequently have only vague ideas regarding it; it has, however, been near enough to them to let them know its deadliness.

As regards chicken-pox, it is fairly common among them; this is not, however, classified as *disom duk* on account of its mild character, and medicines are scarcely used. If any one should become very ill or even die from this, it will be thought to be real small-pox with which this disease is often confused by them, and it is then treated accordingly.

Measles are of yearly occurrence and also feared; it is a fact that many children die from the after-effects of this disease, mostly on account of their ignorance of its nature.

Their ideas about cholera have been mentioned elsewhere; they know its dangerous character and are very much afraid of it. It will be found among the 'prescriptions' that some medicine-men warn against in any way touching the patient and against taking food or drinking water in their houses, and the person who takes the medicine to the house is advised to have a quid of ginger and some other stuff in his mouth as a prophylactic. With regards to small-pox they know the seriousness of the disease, its common course and symptoms and they are very much afraid of it.[3]

In this connection some 'prophylactic' measures of theirs might be mentioned, as they specially aim at guarding against small-pox and cholera. Prophylactic must, however, here be

3. It might be mentioned that what they called *babre ṭikā,* lit. brahmin vaccination, inoculation with small-pox virus, has now and then been practised by them. I have not heard that it is being done at the present time; but I have met old people who have been through the treatment and even have been practising it themselves in their younger days, now some sixty and more years ago. This inoculation was naturally dangerous, and people died from thus acquired small-pox. Since the introduction of calf lymph vaccination, this inoculation has gone out of vogue. The name used shows that the Santals have got vaccination from others. It is not an original practice of theirs.

taken in a sense different from what is the common meaning of the word with us.

These precautionary measures are of a double nature : on the one hand invocation of the spirits and sacrifices, on the other hand medicines.

In the month of *Māgh* (Jan. Febr.)—the month when the Santals change from the old into the new year; some customary remnants show that this month must have been the first of their year; now they follow the Bengali or the Christian year—the entire male population of the village, at a day fixed and after the usual preparations and abstinence, at the end of the village street sacrifice a black female kid and a black pullet and bury them there. At the same time they make vows to the spirits of the village boundaries that they will give them certain sacrifices next year, if they remain free from disease during the whole year. This 'precaution' refers to all kinds of disease, both among men and beasts, also against misfortunes and accidents, but especially also to small-pox and cholera. The sacrifices are followed up by giving some pills to every person found in the village. These pills are made by grinding some 46 different kinds of medicinal stuff and mixing them with country liquor. Where the sacifices are performed they are divided into as many portions as there are house-holds in the village, whereupon the *ojhā* prepares some rice-water in a leaf-cup. With the whole in a winnowing fan the entire assembly starts for the village, and entering every courtyard, beginning from the village street end, the *ojhā* sprinkles the waterpots with the rice-water, whereupon the pills are given. This is thought to secure the inhabitants for the coming year. It may be resorted to even now; but I have no concrete example to refer to.

Precautionary measures taken against small-pox alone are of a similar kind. The male members of the village prepare themselves for a sacrificial performance, and a brown female kid is brought. The *ojhā* engaged for the specific performance comes with a stick and the bark of *Oroxylon indicum* (called

"bear's winnowing fan" by the Santals) and a stick and the bark of *Callotropis gigantea.* At the entrance to the village street the *ojhā* divides the banks into two portions, calling on *Siṅ-boṅgā* (the sun god) and *Dhārti-mae* (mother earth), and orders the village men to bury portions of the bark here and there at the end of the village street, whereupon they walk through the village street with the two sticks. Next they take the kid mentioned to the eastern boundary of the village and here let her graze in the name of *Nāg Nāgin*; when the kid had grazed they walk round the village boundary with the two sticks and the kid; returning to the place where she grazed, she is sacrificed. The decapitated kid and the two sticks are left here. If they escape an epidemic, sacrifices are offered next year. If small-pox should appear in the village, some prophylactic medicines are taken by all.

It might also be mentioned that the Santals make frequent use of several kinds of amulets, worn in a string round the neck, the waist or at the elbow. The most frequently used form is a *māndoli*, a small hollow metal receptacle; medicines are put into the receptacle. Another form is what is called *amsam dhiri*, lit. dysentery stone, really ancient stone-beads found buried here and there, believed to act as a charm to keep dysentery away; these beads are of various colours, some resembling the evacuations of dysentery, and believed, when used as an amulet, to be a charm against the form of the disease, the evacuations of which correspond to the colour. A third form is a bit of a root or a bark tied up with hair (a bear's hair should be there) and kept on the body somewhere. These amulets are intended to keep away disease, and in some cases to keep attacks of a disease at bay (as, e.g., in epilepsy and bronchitis, cough, etc.). They are very commonly used and often tied by mothers on some part of the body of their children.

Going through the list of diseases will show what the Santals have, or rather what they think they have; but the above mentioned symptomatic nomenclature with the possibility of wrong diagnosis must be borne in mind, also that they necessarily have diseases not recognized by them, counting

them as forms of something else than what they really are.

V

There is one matter that might be mentioned in this connection. The Santals have splendid teeth. It is not only that their food is likely less destructive to the teeth than what many other races eat; it has become a habit with them to keep their mouth clean. They brush and clean their teeth at least once daily. It is the first thing they do in the morning, many refusing even to drink water, until they have had a general teeth and mouth cleaning. It is performed with the help of a short twig of a *śāl* branch.

This is chewed at one end, until it becomes something like a brush, and is then vigorously used, whereupon the mouth is rinsed with water. The *śāl* contains some resin or juice that may likely be of some assistance in preserving, in any case in cleaning the teeth. The santal children get accustomed to this mouth cleaning from their infancy, and all look upon it as an absolute necessity. This habit of theirs must to some extent influence their health; if they did not take such care of their teeth, one would likely hear a good deal more than one does of bowel complaints, remembering what they are treating themselves to in the way of food.

When Santals living in this district go to visit friends settled where *śāl* trees are not found, they will always take along with them a good supply of *dātāuni* (as they call these toothbrush twigs) for their own use and to give to their friends who have difficulty in procuring them; they know that such gifts are much appreciated. What has been told will show what the Santals think of the preservation of their teeth. Inflammation of the gums is not frequent. Caries of the teeth is, of course, met with; they believe this to be due to some *tejo,* worms or larvae, that eat the teeth.

A few words on the sanitary conditions of the people may also find a place here.

The Santals are a jungly [rustic] people; they have to be

classified as agriculturists; but they have even now a good deal of the roaming nature of their ancestors in them. They like an open air life, sleep outside, and live more in the open than inside their houses. Their villages are much more sanitary than what one generally sees among the neighbouring races. They are wherever possible, built on fairly high land, the homesteads lying well apart from each other, on both sides of a fairly broad street. The houses are put up round a courtyard, into which all doors lead. No door leads from the street directly into any house. There is one house for the family, until the sons grow up, when these will generally start a new household in separate houses, often on a separate plot of land. There may be two or three houses for human habitation on the same courtyard. I do not think I have ever seen more. Then there is a cowshed and a shed for goats or sheep. There will thus in time be four houses round the yard, one on each side of it. It is seldom really crowded. The sheds for the cattle are geneally open and people often take there their bedsteads to lie on during daytime when the cattle are out. People who are ill are often put there during daytime.

The Santal houses are not sanitary. They have only one door and no windows. They are consequently dark. The roof may permit of some ventilation, but much is left to be desired here. As a rule they cook their food outside but always have a fireplace inside. During the cold season they generally, and also sometimes at other seasons, cook their food inside, the result being that the house, especially at night, is suffocatingly full of smoke. This does not, however, seem to affect the Santals much. In the house they store their rice and all other things for which they can find a place. Here the fowls also live at night. It is, of course, not possible to keep such a house clean, even if they tried. They have a regular house-cleaning, generally once yearly, all being swept and the whole inside sprinkled with a special kind of clay-earth. It is considered the duty of the housewife or whomever she may put to do it, to sweep the floor and also the courtyard every morning before sunrise or just after, and once weekly, if so often, a Santal wife

will clean the floor and often part of the yard with cowdung. This cowdung cleaning seems strange to others, and it may be thought to be a hot-bed for germs, but the Santals feel a house properly plastered in this way to be eminently clean. It keeps down the dust, whatever else it may do.

The santals have practically no furniture. They have some pieces of wood to sit on and also some low stools, always without a back, and they have bedsteads, a frame on four legs with a woven bottom of string, always their own manufacture. They are never large, generally much too short according to our ideas, but properly made; they are comfortable to lie on They use them as beds at night, and as seats during daytime; when not in actual use they are raised on one side and put out of the way. They are light and carried without difficulty by one person from one place to another. They may be said to be sanitary, really in this respect as good as any beds. In case of need they also sleep on mats, on straw or on anything.

The above is a very incomplete description of the daily environment of the Santals, but will be sufficient to give an idea of how they are situated. In certain respects the circumstances are good enough, in others they leave much to be desired.

They are fairly clean with their bodies, some scrupulously so, others rather the opposite. Generally speaking, there is room for improvements in this respect. They wash hands and feet whenever there is a need for it, and use oil of sorts to keep their skin soft and cool. Their own women wash their clothes, boiling them with ashes.

As regards food they are scrupulously clean, both when preparing it and when eating. They wash and scour their plates and cups; if they use leaf-cups, and leaf-plates, these are thrown away after use and never used twice. They will not eat what has been touched by others, except by certain near relatives. A wife may eat what has been left by her hushand, but not *vice versa.* They may eat what has been touched by their children. Except certain near relatives they will not drink water from the same cup, until it has been throughly scoured and washed. They wash their hands and rinse their

mouth before eating and always use their right hand to eat with, the left hand being used for certain ablutions, etc., and never for food or the like. What may be said on this point is that they are in ignorance of the necessity of having a 'clean' water supply, and that they, as a matter of course, do not know what is essential, and what not, to avoid contamination. When they see that the water is clear, they think it is good.

They may be said to be less careful with what they buy of foodstuffs in the *bāzār*-s. And they are not careful enough when they handle things. It is strange, they are sensible and careful with their own, but much less so, if at all, careful with things bought in the shops.

It should further be mentioned that they have a good deal of vermin, especially bugs, in their houses.

Whilst the Santals are very careful to go far away from their houses to pay their debt to the old usurer, as they sometimes style it, they are not so careful with passing water, and when anybody suffers from some bowel complaint, they do not always take the proper precautions, especially not with children. They do not know the need of being careful when spitting.

It should be mentioned that the Santal houses as a general rule are cheap structures, built by themselves. When a person has died in a house, especially when death is due to some dreaded infectious disease, it often happens that they let that house stand unused and build a new one often some distance off. In this way the whole village is sometimes moved to a new site.

VI

Apart from the ingredients which are bought in the *bāzār*-s or from 'medicine'-vendors and which are easily spotted by their foreign names, practically all the stuffs used by the Santal medicine men are such as may be procured in their own villages, or found in their forests.

So far as the writer has been able to judge, the genuine

Santal remedies do not consist of a composition of a large number of ingredients. They have in each case one or two that are considered to be the essential ones; one may hear the medicine-men mention these as such; then they have one or more which are considered necessary to bring out the proper qualities of the essential ingredients, or to make it possible to take the medicine. This, of course, refers to internal medicines. Externally applied medicines may need to be mixed with something, but may also be applied pure.

Santal medicine thus also makes use of what is called vehicles. Most of these will not call for any remarks. They represent what they have or use to make a stuff possible of being administered. It is perhaps more the last mentioned consideration than anything else that operates. The Santals do not object to their medicines being bitter or the like to taste; they rather expect it to be 'tasty' in this way; then they will more readily believe that it is efficacious. It is not rare to hear them criticize European medicines as only tasteless water and consequently ineffective.

Some ingredients used are of a disgusting nature. I remember an old very respectable Santal who told me in confidence that some medicines of his had helped a large number of people against certain diseases. I do not remember what it was, and somehow none of this man's remedies have been recorded; but his great secret was that he in preparing certain medicines made use of *gel bar serma reak id*, human excrements twelve years old.

There is one household medicinal stuff of the Santals which may be mentioned here; it is what they call *kãñji dãk*, lit. sour water, stale rice-water. When they have emptied the earthenware pots in which they have boiled their rice, they pour in a small quantity of water and let this stand in the pot until just before it is to be used for boiling rice next day. Then the pot is 'washed' with this water which is thereupon poured out into a separate pot reserved for the purpose. When they boil their rice, the superfluous water after boiling, a quart or so, is drained off and also poured into the pot mentioned. In a

couple of days the stuff will turn sour, if it is not poured into already sour old *kāñji*.

This *kāñji dāk* is used as food for pigs and cattle which are said to like it. It is further used to exhibit other medicines and also as a medicine in itself, both for human beings and for cattle. Especially when intended for medicine it may be kept for a long time. The writer has seen some *kāñji dāk* which he was informed was five years old, an awfully horrid smelling stuff. It is kept separate in a covered pot, some new *kāñji* being added occasionally to replenish what has evaporated.

VII

As regards the collection of Santal medicines the following may be noted :

As mentioned above there are no special ceremonies or religious observances connected with the collecting of the different ingredients, so far as the work of the ordinary medicine-men is concerned. *Ojhā*-s might be thought to try to copy Hindu medicine-men; but it is explicitly denied that they use *mantar*-s or invocations. The 'religious' side of their work comes in, when they are going to apply their remedies. This has been described in detail in the paper *The Santals and Disease.*

If some of the ingredients are commonly known and no mistake is possible, or they are of the kind that has to be bought in the *bāzār*, the medicine-man may ask those who have called him in, to fetch, or, as the case may be, to buy the stuff wanted. As a rule he will bring all himself; as might be expected, he will not give much concrete information regarding the stuff he uses, or concerning his way of finding it. It is unnecessary to say more on this point.

An *ojhā* or medicine-man will generally procure and keep with him a supply of ingredients that are not easily procurable. Thus, if he happens to come across a rare medicinal tree, shrub or plant, he will take some of the bark, or whatever may be used, home with him, and in any case keep in remembrance the exact spot where he has seen it. A Santal is naturally obser-

vant of details; they do not soon forget what they have seen with their own eyes.

The bulk of the Santals has up to the present time been living in parts of the country more or less covered by jungle or forest; they have generally not far to go to find what they want. With some ingredients there will, of course, be difficulties. It may be impossible to find the exact stuff. In such cases one ingredient may have to be left out, or something similar substituted. I understand that this is often done. The patient naturally has to pay the cost of the medicines, besides the fee.

The medicines employed are mostly part of trees, shrubs or plants. Sometimes the leaves or the fruits are used; frequently it is the bark; or the roots, or the bark of the roots. This last is so much the case that a common name of theirs for their own medicines, as distinguished from other, e.g., European medicines, is *rehet ran*, lit. root medicine. They have an idea that the roots of a tree, or what is underground, will preserve the inherent qualities better than what is above ground, exposed to all kinds of influences.

The medicine-man who goes to find medicines will carry along a *khontā*, the instrument always used for digging for medicines. A *khontā* is a wooden bar with a flat bit of iron fixed in one end, or it may be simply a bar of hard wood (so was the custom in former times, it is said). In such cases the wood is either *hesel (Anogeissus latifolia* : Wall.), reputed to be the hardest wood they have, or *icak* (*Woodfordia floribunda* : Sahsb.). This last is common in the forests and often used by the *ojhā*, e.g., at the time of *ran jagao*, when the *ojhā* shows his disciples some of the most common root medicines.

VIII

As regards the preparation and administration of the medicines the following may be mentioned :

Some stuff may be given in its natural form without any

special preparation, outside what may be done with foodstuffs or drinks, but will in such cases, if taken in, scarcely be classified as medicine, any more with the Santals than with others. An example of this is the use of *sinjo*, the *bael* fruit (*Aegle marmelos* : Correa.).

Some stuff are macernated in *gotom*, the Santal name for what in North India is generally known as *ghi*, clarified unsalted butter, specially in *gotom* prepared from the milk of cows, not so often from the milk of buffalo-cows, which is in many cases considered unsuitable for medicinal purposes by the Santals, or even what doctors call contra-indicated. Some stuffs are soaked in mustard oil, others again soaked in water or some other fluid and then strained. Some medicines are boiled, and even boiled down, e.g., to the consistency of molasses. Some are prepared by infusion or by decoction.

Only in chronic cases, or in diseases that are recognized and known to take some time to run their natural course, will they resort to a mode of preparation that requires any length of time. The general custom is to prepare the medicine on the spot for immediate use.

The most common way of preparing medicines is to grind the ingredients on a flat stone with the help of a cylindrical stone called *gurgu*, both found in every Santal household as indispensable utensils, and used for domestic purposes everyday, specially to grind turmeric and spices. These two stone implements are, as a matter of course, well cleaned both before and after being used for preparing medicines, before, to be sure that no foreign particle shall vitiate the medicine and after the operation to ensure clean food.

The proceedings when using the *gurgu* are so characteristic, that a description may be of interest. When the stones have been properly cleaned, the medicine-man calls for a cup of water and some *sarjom* leaves (*sarjom* is the Santali name for the tree generally known as *śāl*, *Shorea robusta* : Gartn.); the leaves are fairly large and strong, and otherwise used by the people for making leaf-cups of sorts and plates. He thereupon takes the medicinal ingredients, roots, bark, leaves, or whatever

they may be, one by one, and carefully washes them to remove all traces of earth or dirt.

The man takes his first ingredient, washes and crushes the stuff, using one end of the *gurgu* as a hammer, and grinds it by rolling the *gurgu* a sufficient number of times over it. He then adds his next ingredient, treating it in the same way, and so on, until the whole is crushed, ground and mixed. As the process goes on, a little water is sprinkled on by hand.

The medicine-man now takes a small leaf-cup made of one *sarjom* leaf, and squeezing the prepared ingredients in his right hand he lets the water trickle down into the leaf-cup; one to two ounces of fluid extract will be the result. If a larger dose is wanted, the ingredients may be ground once more with water added and then squeezed anew.

The thus prepared medicine is thereupon taken in the leaf-cup to the patient who drinks the stuff, being instructed to lie quietly down for a while after taking the dose, to prevent vomiting, if there should be any such tendency.

Most internal medicines are administered as described. In some cases the stuff is warmed a little, and if anything else than a cold extract, prepared as described, is wanted, the medicine is boiled, as mentioned above, in water, in mustard oil or in *ghi*.

Internal medicine is preferably given on an empty stomach in the morning, repeated at noon and again in the evening, if deemed necessary.

When there is no immediate danger, consequently no great hurry, and it is understood from the known or supposed nature of the disease that it will take time to run its course, the medicine may be made up into pills and left with the patient with instructions to take them at certain stated times. The same may be done with liquid stuff, specially when the vehicle is some kind of oil, *ghi* or spirits. Some of the medicine-men seem to have a predilection for using this last stuff, something called *paura*, spirits distilled from the dried *mahuā* blossoms. In all such cases the personal presence of the medicine-man is not deemed essential.

It is in this connection of interest to observe, how instruc-

tions are given as to dosage. With freshly prepared liquid medicine the amount given is contents of a one leaf leaf-cup, anything from one to two ounces.[4]

With some preparations the patient is instructed to take as much as will go in a mussel shell, of which they generally distinguish three sizes, a small, a middle-sized and a large one, in size equal to a small tea-spoon, a small desert spoon or a small table spoon, respectively. If larger quantities are to be given at a time, they use either their own different kinds of leaf-cups, made of more than one leaf, as standards, or the common Indian measures for liquids. In the 'prescriptions', when measures are specially given, they have generally been reduced to their English equivalents.

When the medicine is given in the form of pills, the size of these vary considerably. The size is given by reference to some well-known natural object of a fairly constant size. It may be a fly's head, a mustard seed, a pea, the excrement of a hare, of a goat or of some other animal, a cross-bow ball, and so on.

It will be observed that the dosage varies considerably. In some cases, perhaps generally, it is not really large; in others it must be called heroic. In such cases, knowing what they are about, they will watch developments and when necessary, administer counteracting medicines.

If the remedy is for external use, an extract is not considered sufficient; something stronger is wanted. The ingredients are crushed and ground as described, then mixed with a little water as necessary, and placed in a potsherd which is put over some burning charcoal until the whole is sufficiently heated, that is to say, made just warm enough not to burn. The medicine-man then applies the medicine with his left hand.[5]

4. This cup is made in the following way : a *śāl* leaf is taken, the tip is just nipped off, whereupon the two ends of the leaf are folded doubly, a bit of stiff straw being pierced through the folds to keep the ends in position.

5. The right hand is not considered proper or felicitous. The left hand is constantly used in their medical practice. Why this should be so, is not so difficult to understand. When they say that it is infelicitous to use the right hand, it may possibly be to have an excuse for obviating

The plastering on of medicines is sometimes carried to extremes by ignorant persons and may become the cause of serious inconvenience.

When necessary or desirable the plaster or embrocation may be covered by a plantain leaf tied on. Bandages, as we understand the term, are, of course, unknown; rags and strips of old cloth, washed or dirty, have to do service. The plantain leaf is really a good substitute for an oilcloth or the like, and has the advantage of costing them nothing.

In connection with external remedies the following further methods may be noted.

The medicine is sometimes burnt to ashes and then sprinkled on. It may be rubbed or mixed with one's own saliva. Cuts may be first treated by passing water on them and then covering them with lime burnt from mussels.

In certain cases it will be observed that the medicine-man chews the stuff and thereupon spits it on, either in a bit of cloth to be used for the application, or directly on the affected part (such as the eye or the ear). Sometimes a fowl's feather is used for the application of the medicine.

When bandaging bone-fractures splints are used made of cut pieces of *sar* (*Saccharum sara*, L.), tied together at the ends so as to become stiff lengthways and flexible the other way. They are not unserviceable.

For certain maladies they resort to a kind of medicinal steam-bath. A simple steam-bath seems to be unknown. The ground, or otherwise prepared, ingredients are put in a generally new earthenware pot, the mouth of which is tied over with

the use of this hand. The left hand is otherwise the hand of dishonour, very much more so with Santals than with us, because it, as remarked above, is used for certain undignified purposes, especially for certain ablutions. To use the left hand for any ceremonial purpose, for handling food, for greeting, or for handling anything to anybody, would be considered grossly insulting in a person who is supposed to know the proprieties. Why the left hand with all this against it, should be propitious for applying external medicine—for this I have never heard an explanation offered. To reduce *prolapsus recti* they use the foot.

a leaf-plate. The contents are brought to boiling point, the leaf-plate is pierced to let the steam escape, and the pot is put under a bedstead (with a string bottom), on which the patient lies down covered with cloth that reaches down to the ground all round. The purpose is to make the patient perspire profusely with the help of 'medicated' steam.

Another 'medicated' steam-bath is given in the following manner. Some medicinal ingredients are ground and mixed with *ghi*. A bit of a shoot of a certain tree (*jizyphus Jujuba*, Lam.), about six inches long, is covered three fourths of its length with the medicine. This 'candle' is stuck in a ball of cow-dung, the uncovered bit in the cow-dung, the medicine covered part standing out. The patient is made to sit on a low stool and is covered up with a sheet. The 'candle' is lighted and kept under the cloth, until it is burnt down. The patient must not look at the 'candle' during the whole operation; otherwise it will not be effective. This steaming is repeated several times, the object being to remove oedema.

In certain cases they made use of a proceeding, the idea of which seems to be to smoke out the *tejo*-s (worms) that are supposed to be the cause of the malady. It is a ludicrous sight to see when used, e.g., for *reṅgol*, as the worms are called that are supposed to cause caries of the teeth, 'eat' the teeth, as they express themselves.

A kind of cupping is sometimes, but very seldom, resorted to. My impression is that very few Santals know anything about this practice; it is used by non-Santal medicine-men.

Surgery is practically unknown among them. They have no implements. They may lance a boil with a red hot iron, or make a puncture with a long thorn. Thorns, or now-a-days mostly needles, are used for puncturing some peculiar nose-trouble, called *simbra* by the Santals, and very common with them, whatever it may be. Strangely enough it is often women who perform this operation.

The disastrous way of trying to cure cataract by pushing down the lense with a needle I have not heard of any Santal doing; but I have met several Santals who have lost their sight

utterly by having this done to them by persons of other races.

As a curiosity it may be mentioned that the writer has heard it told, that they have resorted to making a person dead drunk in order to make him insensible to pain when they have been forced to handle painful accidents.

They may be able to stand pain, but perhaps not more than other people belonging to the same stage. As an example of what they are able to do, the following may serve. Some people were out watching silkworms; then one man was bitten in the foot by a poisonous snake. They had a fire burning, and they took at once a firebrand and applied it, burning the whole out. The man did it himself.

IX

What has been stated above is a description of the way in which medicines are ordinarily collected, prepared and administered. There will always be room for departure from the commonly accepted or practised course. In connection with disease many considerations of a personal nature will make themselves felt, combined with the feeling of difficulties caused by their lack of ability and knowledge, by fear and superstition, both with the patient and with the medicine-man. Religion will naturally come in, not to appeal to the goodness or mercy of the spirit world, but to attempt to appease or satisfy the supposed enemies, and to induce some special spirit-powers to keep the supposed acting inimical powers away, or to drive these away, if they are at all able to effect this; also these spirits have to be 'paid' for their services. This matter has been dealt with in the paper *The Santals and Disease*, to which the reader must be referred.

Some of the departures from the ordinary may be of interest ethnologically, and also of interest to the student of human nature.

A fairly large number of remedies are ordered to be given on certain days to be efficacious, especially on a Sunday morning, the very first thing, even before they pay their 'dues' to

nature. Sunday is considered a felicitous day, not only for administering medicine, but also for a good many other things.

In some 'prescriptions' instructions are given, that the water to be used for the preparation of the medicine has to be dew. The dew is collected in the following way : a clean piece of cloth is taken out and dragged over the grass in the morning and then squeezed out. The dew is supposed to have certain qualities due to its mysterious appearance.

Similar qualities are attributed to hail-water. Hail-stones are sometimes collected and kept in a bottle for future possible medicinal use. That the hail immediately melts does not matter; the supposed quality remains, as the propelling force is supposed to remain in a spent bullet or in a supposed 'thunderbolt'. I cannot remember having heard that rainwater is especially used, as might have been expected.

Considerations of a similar nature are probably underlying certain specific instructions given in connection with some remedies. Certain qualities of purity, that is to say, of being untouched, or unused, or of being unexposed to extraneous influence, are supposed to be necessary for, and to give efficiency, to the medicine. Foreign influence is in certain cases supposed to hinder or vitiate the action of the remedies.

The simplest form this takes is the employment of a new, unused earthenware pot for preparing or administering a remedy. It has likely also something to do with the idea of cleanliness, as we understand it. The idea especially to be compared is, however, that of religious or social contamination. Dirt is objectionable, but may be removed. When a vessel has been handled by anybody for use some undefinable matter of quality or influence of this somebody is supposed to stick to the vessel; it becomes polluted for others, whilst it is quite good for those who have it in use.

When girls who have not been married are mentioned now and then in connection with certain ingredients, it is probably not so much the idea of virginity that is thought of, as the fact that such a girl has not been exposed to, or is not under the influence of other people than her own family, and perhaps

specially of *boṅgā*-s, worshipped by the members of another family than that of her father. To understand this it should be remembered that a Santal woman has no religion of her own; all her regular relations with the supernatural have to go through her male relatives, father, brother, husband, or son, as the case may be. A woman has to keep away from participation in sacrifices. When married she is supposed to be under the influence, or within the sphere, of her husband's *boṅgā*-s.[6]

The above statement should not be taken as implying that the Santals disregard morality. There is much to be desired in this respect among them; but they really prize chastity in their womankind. An unmarried loose character would not in any way be thought proper for the herein mentioned cases.

It will be observed that chastity is expressly demanded in many 'prescriptions'; see remarks at the end of this section. In one 'prescription' it is said : 'You, the medicine-applier, must be chaste and have no intercourse with women, and the patient must remain so until he is cured'. Even when applyingmedicines to cattle this is mentioned.

Some similar vague idea seems to be underlying the application of the warm dung of a heifer which has not calved.

In one case (for *Tinea tonsuraus*) instructions are given that the maternal uncle of a child suffering from this should bathe on a Sunday morning, then come and after wiping his feet wring out the water from his wet towel on the head of his nephew or niece. These relatives (maternal uncle and nephews or nieces) are supposed to show each other particular respect and honour, honour each other like honouring the sun (or Supreme Being), as they express themselves.

6. To avoid misunderstanding, it might be noted that it is the *boṅgā*-s a Santal woman is kept away from, that is to say, from all acts through which relations or connection with any *boṅgā* are supposed to be established. A woman is free to invoke the Supreme Being; she could not be prevented. If she tried to establish any connection with a *boṅgā* through a sacrifice, she would, if discovered, be treated as a witch.

In some of the 'prescriptions' it is said that a potsherd of a pot broken by falling down from (the head of) an unmarried girl will be efficacious for certain sores, when rubbed in water and applied. The same is, however, also said about a potsherd that has been turned out of its hole by a certain snake, called *tutri (Eryx conicus)* by the Santals.

One medicine for puerperal fever is to take some leaves of one tree and the roots of another, grind these and mix them with the urine of the woman's husband who is to apply the remedy to her abdomen; he himself must do it, no one else.

In one case it is ordered that the medicine-man must not see the patient for two weeks, but must send the medicine by someone else. The reason for this is not obvious. In another class of 'prescriptions' the applier is warned to keep his breath during the operation. It has to be done in one breathing, the object apparently being to prevent contamination, and thereby lack of efficiency, by the remedy being exposed to the breath of the person acting. Strangely enough, this applies only during the operation itself, not at any other time.

In certain cases the patient is instructed to walk home, or to go inside his house, after the application of the remedy, without looking back or anywhere. This is probably something of the same nature as that mentioned above; the patient is to be guarded against extraneous influence, only that it seems as if the object in view here is to prevent the patient from, in some way or other, becoming unsuitable for the effects of the medicine, more than to secure the efficiency of the remedy itself.

Something of the same kind also applies to the *ojhã*; in certain circumstances he has to walk away from where the patient is, without looking backwards or to any side. He is taking something dangerous along with him, and this must not get an opportunity of slipping back to the patient.

There is one more matter to be mentioned in this connection. It will be observed that in some cases it is ordained that those to be treated are to practise what has been translated 'become priests,' an expression that will need some explanation.

The Santals have a custom (also met with among other races) strictly adhered to : during the night previous to the performance of any sacrifice all concerned, but especially the sacrificer, sleep on a mat, or on straw, on the floor, and not on bed, and keep themselves away from women in order not to be polluted. As elsewhere remarked the women are kept away from religious observances; they are not fit for them and would pollute. It might also be noted that the Santals speak of sexual intercourse, even between couples, as a bad act, an evil doing that pollutes, the purification from which comes when a child is born. It is unnecessary here further to point out what may be implied by the demand of this precaution. The same is to be observed previous to 'medicine' being administered to cure barrenness in a women.

X

In connection with Santal medicine a few household remedies of theirs are to be mentioned that have not found a place among the prescriptions, or have not been properly described. A medicineman or an *ojhā* may make use of these, or order them to be used; but they are not considered as being inside the special domain of the profession, more than, *e.g.*, a hot-water bottle would be with us.

The household remedies to be mentioned here are four.

In cases of local pain, also when this is combined with some swelling, they report to what by them is called *tobak*. The point of a sickle (often more than one so heated, so as to enable the operator to work quickly) is made red hot, and the painful or inflamed spot is pricked with this, that is, just touched, the distance between each prick being anything from half an inch to one inch. Before pricking the exact spots are marked with ashes, just a little. The operation is said to be not very painful. It is often resorted to as a cure for a kind of headache. I remember when I first saw the marks of this on the forehead of a Santal, I thought it must be some kind of tatto, the marks being quite artistically arranged.

If an infant child is to be treated in this way, a needle is used instead of sickle. The operation is meant to be what is called a counter-irritant, and is aseptic.

Another counter-irritant of theirs is what they call *soso*. *Soso* is the Santal name for the well-known marking-nut tree very common in their part of the country.

The pericarp contains a juice which the Santals make constant use of for several purposes, especially, for blistering. When a blister is wanted, they take the pericarp and cut a small hole in it so as to be able to get at the juice that is found inside. Having wound a little thread or the like round a small bit of wood they insert this into the pericarp and let it be saturated with the juice. With the 'brush' thus prepared the skin is marked where, and to such an extent as, wanted. In a few hours a blister will commence to develop with gradual accumulation of fluid. After a couple of days this is punctured. If careful, there is no suppuration. It is painless. It is extensively used both on human beings and cattle.

It might also be mentioned that the Santals 'distil' an oil of the pericarp. This is placed in a small earthenware pot with a small hole in the bottom. The pot is exposed to heat whereby the oil exudes; dropping through the hole mentioned, it is collected in a 'bottle'. The oil is generally stored in a receptacle which is a buffalo's scrotum. The oil is used medicinally, mostly, however, for lubricating purposes.

The other household remedies referred to are *sekao* and *iskir* both most excellent when properly applied.

Sekao is a kind of fomentation, given in the following way : a large potsherd with live charcoal is put on the floor close to the person who is to be treated. The part of the body to be fomented is smeared with *ghi*; the hand of the operator is kept over the live coals, till it is as hot as can be borne and thereupon pressed gently down on the affected part and kept there for a short while, until the heat is used up. The operation is then repeated and continued for a shorter or longer period; it is frequently combined with more or less massage.

Sometimes a knot of the leaves of the Ricinus plant is used

instead of the hand; the leaves are so tied together that they form a kind of ball with a narrow neck, used as a handle. This may be more pleasant for the operator, but may become too hot for the patient.

Sekao is very commonly used and resorted to for all kinds of painful swellings and internal pain. Combined with *iskir* it is what they at once apply when something occurs, before they call in the 'doctor'.

Iskir is massage and is given for what is called *hadi* and other complaints of a similar nature. It is very commonly restored to in order to counteract muscular pain due to over-exertion, rheumatic pains, fatigue, or anything of a similar nature.

To be able to give *sekao* and *iskir* is considered to be a necessary part of a Santal woman's education; a woman unable to give this would not be considered desirable as a wife. Men also know the art. All are naturally not equally expert; some are really excellent and have a natural aptitude, the proper touch; most will be able to do it somehow.[7]

7. This is followed by *Classified List of Santal 'Prescriptions'*, which, along with the *Index* to the *List*, occupies pp. 161-424 of Bodding's work.—*Ed.*

ALCHEMY, CHEMISTRY, BOTANY ETC.

ON ALCHEMY IN INDIA[1]

AL-BĪRŪNĪ

ON ALCHEMY AMONG THE HINDUS IN GENERAL

We understand by witchcraft, making by some kind of delusion a thing appear to the senses as something different from what it is in reality. Taken in this sense, it is far spread among people. Understood, however, as common people understand it, as the producing of something which is impossible, it is a thing which does not lie within the limits of reality. For as that which is impossible cannot be produced, the whole affair is nothing but a gross deception. Therefore witchcraft in this sense has nothing whatever to do with science.

One of the species of witchcraft is alchemy, though it is generally not called by this name. But if a man takes a bit of cotton and makes it appear as a bit of gold, what would you call this but a piece of witchcraft ? It is quite the same as if he were to take a bit of silver and make it appear as gold, only with this difference, that the latter is a generally-known process, *i.e.*, the gilding of silver, the former is not.

The Hindus do not pay particular attention to alchemy, but no nation is entirely free from it, and one nation has more bias for it than another, which must not be construed as proving intelligence or ignorance; for we find that many intelligent people are entirely given to alchemy, whilst ignorant people ridicule the art and its adepts. Those intelligent people, though boisterously exulting over their make-believe science, are not to be blamed for occupying themselves with alchemy, for their motive is simply excessive eagerness for acquiring fortune and for avoiding misfortune. Once a sage was asked why

1. In Sachau's translation *Alberuni's India* this chapter is entitled : "On Hindu Sciences which prey on the ignorance of people".—Ed.

scholars always flock to the doors of the rich, whilst the rich are not inclined to call at the doors of scholars. "The scholars," he answered, "are well aware of the use of money, but the rich are ignorant of the nobility of science." On the other hand, ignorant people are not to be praised, although they behave quite quietly, simply because they abstain from alchemy, for their motives are objectionable ones, rather practical results of innate ignorance and stupidity than anything else.

The adepts in this art try to keep it concealed, and shrink back from intercourse with those who do not belong to them. Therefore I have not been able to learn from the Hindus which methods they follow in this science, and what element they principally use, whether a mineral or an animal or a vegetable one. I only heard them speaking of the process of *sublimation*, of *calcination*, of *analysis* and of the *waxing of talc*, which they call in their language *tālaka*, and so I guess that they incline towards the mineralogical method of alchemy.

THE SCIENCE OF RASĀYANA

They have science similar to alchemy which is quite peculiar to them. They call it *Rasāyana*, a word composed with *rasa*, i.e. gold. It means an art which is restricted to certain operations, drugs, and compound medicines, most of which are taken from plants. Its principles restore the health of those who were ill beyond hope, and give back youth to fading old age, so that people become again what they were in the age near puberty; white hair becomes black again, the keenness of the senses is restored as well as the capacity for juvenile agility, and even for cohabitation, and the life of people in this world is even extended to a long period. And why not ? Have we not already mentioned on the authority of Patañjali that one of the methods leading to liberation is *Rasāyana* ? What man would hear this, being inclined to take it for truth, and not dart off into foolish joy and not honour the master of such a wonderful art by popping the choicest bit of his meal into his mouth ?

NĀGĀRJUNA, THE AUTHOR OF A BOOK ON RASĀYANA

A famous representative of this art was Nāgārjuna, a native of the fort Daihak, near Somanāth. He excelled in it, and composed a book which contains the substance of the whole literature on this subject, and is very rare. He lived nearly a hundred years before our time.

THE ALCHEMIST VYĀḌI IN THE TIME OF KING VIKRAMĀDITYA

In the time of the King Vikramāditya, there lived in the city of Ujain, a man of the name of Vyāḍi, who had turned his whole attention to this science, and had ruined on account of it both his life and property, but all his zeal did not even avail him so much as to help him to things which, under ordinary circumstances, are easily obtained. Becoming restricted in his means, he conceived a disgust to that which had been the object of all his exertions, and sat down on the bank of a river sighing, sorrowful, and despairing. He held in his hand his *pharmacopoeia*, from which he used to take the prescriptions for his medicines, but now he began to throw one leaf of it after the other into the water. A harlot happened to sit on the bank of the same river farther down, who, on seeing the leaves pass by, gathered them, and fished up some relating to *Rasāyana*. Vyāḍi did not notice her till all the leaves of his book had gone. Then the woman came to him, asking why he had done so with his book, whereupon he answered, "Because I have derived no advantage from it. I have not obtained what I ought to have obtained; for *its* sake I have become bankrupt after having had great treasures, and now I am miserable after having so long been in the hope of obtaining happiness." The harlot spoke: "Do not give up a pursuit in which you have spent your life; do not despair of the possibility of a thing which all sages before you have shown to be true. Perhaps the obstacle which prevents you from realising your plans is only of an accidental nature, which may perhaps be removed by an

accident. I have much solid cash. It is all yours that you may spend it on the realisation of your plans." Thereupon Vyāḍi resumed his work.

However, books of this kind are written in an enigmatic style. So he happened to misunderstand a word in the prescription of a medicine, which meant *oil* and *human blood*, both being required for it. It was written *raktāmala*, and he thought it meant *red myrobalanon*. When he used the medicine it had no effect whatsoever. Now he began to concoct the various drugs, but the flame touched his head and dried up his brain. Therefore, he oiled himself with oil, pouring it in great quantity over his skull. One day he rose to step away from the fireplace for some business or other, but as there happened to be a peg projecting from the roof right above his head, he knocked his head against it, and the blood began to flow. On account of the pain which he felt, he looked downward, and in consequence some drops of blood mixed with oil dropped from the upper part of his skull into the cauldron without his noticing it. When, then, the concocting process was finished and he and his wife besmeared themselves with the concoction in order to try it, they both flew up into the air. Vikramāditya on hearing of this affair left his castle, and proceeded to the market-place in order to see them with his own eyes. Then the man shouted to him, "Open thy mouth for my saliva." The king, however, being disgusted, did not do it, and so the saliva fell down near the door, and immediately the threshold was filled with gold. Vyāḍi and the woman flew to any place they liked. He has composed famous books on this science. People say that both man and wife are still alive.

STORY ABOUT THE PIECE OF SILVER IN THE DOOR OF THE GOVERNMENT-HOUSE IN DHĀRA

A similar tale is the following : In the city of Dhāra, the capital of Mālava, which is in our days ruled by Bhojadeva, there lies in the door of the Government-house an oblong piece of pure silver, in which the outlines of the limbs of a man

are visible. Its origin is accounted for by the following story : Once in olden times a man went to a king of theirs, bringing him a *Rasāyana*, the use of which would make him immortal, victorious, invincible, and capable of doing everything he desired. He asked the king to come alone to the place of their meeting, and the king gave orders to keep in readiness all the man required.

The man began to boil the oil for several days, until at last it acquired consistency. Then he spoke to the king : "Spring into it and I shall finish the process." But the king, terrified at what he saw, had not the courage to dive into it. The man, on perceiving his cowardice, spoke to him : "If you have not sufficient courage, and will not do it for yourself, will you allow me myself to do it ?" Whereupon the king answered, "Do as you like." Now he produced several packets of drugs, and instructed him that when such and such symptoms should appear, he should throw upon him this or that packet. Then the man stepped forward to the cauldron and threw himself into it, and at once he was dissolved and reduced into pulp. Now the king proceeded according to his instruction, but when he had nearly finished the process, and there remained only one packet that was not yet thrown into the mass, he began to be anxious, and to think what might happen to his realm, in case the man should return to life as an *immortal*, *victorious*, *invincible* person, as has above been mentioned. And so he thought it preferable not to throw the last packet into the mass. The consequence was that the cauldron became cold, and the dissolved man became consolidated in the shape of the said piece of silver.

STORY OF THE FRUIT-SELLER RAṄKA AND THE KING VALLABHA

The Hindus tell a tale about Vallabha, the king of the city of Vallabhī.

A man of the rank of a *Siddha* asked a herdsman with reference to a plant called *Thohar*, of the species of the *Lactaria*,

from which milk flows when they are torn off, whether he had ever seen *Lactaria* from which blood flows instead of milk. When the herdsman declared he had, he gave him some drink-money that he should show it to him, which he did. When the man now saw the plant, he set fire to it, and threw the dog of the herdsman into the flame. Enraged thereby, the herdsman caught the man, and did with him the same as he had done to his dog. Then he waited till the fire was extinguished, and found both the man and the dog, but turned into gold. He took the dog with him, but left the man on the spot.

Now some peasant happened to find it. He cut off a finger, and went to a fruit-seller who was called Raṅka, i. e. *the poor*, because he was an utter pauper, and evidently near bankruptcy. After the peasant had bought from him what he wanted, he returned to the golden man, and then he found that in the place where the cut off finger had been, a new finger had grown. He cut it off a second time, and bought again from the same fruit-seller all that he wanted. But when the fruit-seller asked him whence he had the finger, he was stupid enough to tell him. So Raṅka went out to the body of the Siddha, and brought it on a carriage to his house. He stayed in his old abode, but managed by degrees to buy the whole town. The king Vallabha desired to own the same town, and asked him to cede it to him for money, but Raṅka declined. Being however afraid of the king's resentment, he fled to the lord of Almanṣūra, made him presents of money, and asked him to help him by a naval force. The lord of Almanṣūra complied with his desire, and assisted him. So he made a night-attack upon the king Vallabha, and killed him and his people, and destroyed his town. People say that still in our time there are such traces left in that country as are found in places which were destroyed by an unexpected night-attack.

The greediness of the ignorant Hindu princes for gold-making does not know any limit. If any one of them wanted to carry out a scheme of gold-making, and people advised him to kill a number of fine little children, the monster would not

refrain from such a crime; he would throw them into the fire. If this precious science of Rasāyana were banished to the utmost limits of the world, where it is unattainable to anybody, it would be the best.

AN ERANIAN TRADITION

According to the Eranian tradition, Isfandiyād is said to have spoken when dying : "Kāūs had been given the power and the miraculous things mentioned in the Book of the Law. Finally he went to the mountain Kāf as a decrepit man, bent down by old age, but he returned thence as a lively youth of well-proportioned figure and full of force, having made the clouds his carriage, as God allowed him."

ON THE BIRD GARUḌA

As regards charms and incantations, the Hindus have a firm belief in them, and they, as a rule, are much inclined towards them. The book which treats of those things is considered as a work of Garuḍa, a bird on which Nārāyaṇa rode. Some people describe this bird in such a way as to indicate a Ṣifrid-bird and its doings. It is an enemy of fish, catching them. As a rule, animals have by nature an aversion to their opponents, and try to beware of them; here, however, there is an exception to this rule. For when this bird flutters above the water and swims on it, the fish rise from the deep to the surface, and make it easy to him to catch them, as if he had bound them by his spell. Others describe it with such characteristics as might indicate a stork. The *Vāyu-purāṇa* attributes to it a pale colour. On the whole, Garuḍa comes nearer to a stork than to a Ṣifrid, as the stork is by nature, like Garuḍa, a destroyer of snakes.

THE EFFECT OF CHARMS ON THE BITE OF SERPENTS

Most of their charms are intended for those who have been bitten by serpents. Their excessive confidence in them is

shown by this, which I heard a man say, that he had seen a dead man who had died from the bite of a serpent, but after the charm had been applied he had been restored to life, and remained alive, moving about like all others.

Another man I heard as he told the following story: "He had seen a man who had died from the bite of a serpent. A charm was applied, and in consequence he rose, spoke, made his will, showed where he had deposited his treasures, and gave all necessary information about them. But when he inhaled the smell of a dish, he fell down dead, life being completely extinct."

It is a Hindu custom that when a man has been bitten by a venomous serpent, and they have no charmer at hand, they bind the bitten man on a bundle of reeds, and place on him a leaf on which is written a blessing for that person who will accidentally light upon him, and save him by a charm from destruction.

I, for my part, do not know what I am to say about these things, since I do not believe in them. Once a man who had very little belief in reality, and much less in the tricks of jugglers, told me that he had been poisoned, and that people had sent him some Hindus possessing the knowledge of charms. They sang their charms before him, and this had a quieting effect upon him, and soon he felt that he became better and better, whilst they were drawing lines in the air with their hands and with twigs.

HUNTING PRACTICES

I myself have witnessed that in hunting gazelles they caught them with the hand. One Hindu even went so far as to assert that he, without catching the gazelle, would drive it before him and lead it straight into the kitchen. This, however, rests, as I believe I have found out, simply on the device of slowly and constantly accustoming the animals to one and the same melody. Our people, too, practise the same when hunting the ibex, which is more wild even than the gazelle. When they

see the animals resting, they begin to walk round them in a circle, singing one and the same melody so long until the animals are accustomed to it. Then they make the circle more and more narrow, till at last they come near enough to shoot at the animals which lie there in perfect rest.

The shooters of Kaṭā-birds have a custom of beating copper-vessels during the night with one and the same kind of beat, and they manage to catch them with the hand. If, however, the beat is changed, the birds fly off in all directions.

All these things are peculiar customs which have nothing whatsoever to do with charms. Sometimes the Hindus are considered as sorcerers because of their playing with balls on raised beams or on tight ropes, but tricks of this kind are common to all nations.

[Translated from Arabic by E. C. Sachau]

AL-BĪRŪNĪ AND INDIAN ALCHEMY

JEAN FILLIOZAT

The work of great al-Bīrūnī is one of the essential sources of our knowledge of India of the high Middle Age. Its thorough analysis that Reinaud had first given in his *Memoire geographique, historique et scientifique sur l'Inde anterieurement au milieu du XI^e siecle de l'ere chretienne, d'apres les ecrivains arabes, persans et chinois* (*Memoires de l'Institut National de France, Academie des Inscriptions et Belles-Lettres*, t.xviii. part 2, pp. 1-399 and pp. 565-566) is a landmark in the history of Indology. Within a few months, the centenary of this work, published in Paris in 1849, happens to coincide with the millenary of the great Arab Indologist by which its value has been made known to all.

The valuable edition and translation of al-Bīrūnī's *India* by Edward C. Sachau (1886 and 1888) have supplied all the details of its information and have been the fundamental tool of research since the last sixty years. But it has not made the *Memoire* of Reinaud useless, because the latter compares the data of al-Bīrūnī with the Arabic, Persian and Chinese sources and with the Indian sources themselves. Its method will always remain indispensable for the proper interpretation of al-Bīrūnī's text.

Since it has been misunderstood, seriously erroneous idea regarding the history of Indian alchemy has been drawn from this text.

Some of the most celebrated texts of Indian alchemy are traditionally attributed to Nāgārjuna, named in this particular occasion as *siddha*, 'Perfect'. He is thus placed in the category of superhuman savants, various lists of whom are given which includes some personage who cannot possibly be considered very ancient. Besides, different texts tend to identify the alchemist Nāgārjuna with the great Buddhist chief abbot of the same name, contemporary with Kaniṣka, or in any case, belonging to the first centuries of the Christian era. Now, an information in al-Bīrūnī seemed to invalidate the identification

and to bring down the alchemist Nāgārjuna to the 10th century. As a matter of fact, al-Bīrūnī mentions a famous Indian alchemist and an author of an important treatise, one Nāgārjuna, native of the fort of Daihak near Somnāth, who lived approximately hundred years before his (al-Bīrūnī's) time, therefore in the 10th century.

This information has been accepted, as it is, notably by Winternitz *(Geschichte der indischen Litteratur*, vol. iii, Leipzig, 1920, p. 552). It would result in that Nāgārjuna, considered by the Indian tradition as one of the founders of alchemy in India, would not be the celebrated Buddhist personage, but a late man bearing the same name. The tradition confusing him with the Buddhist personage would be posterior to the 10th century and Indian alchemy would take shape only at this time, in spite of its pretensions to antiquity. Indian alchemy would therefore be more recent than the beginnings of Arabic alchemy and might have been constituted in imitation of the latter.

Comparison of a Chinese evidence with that of al-Bīrūnī demolishes this entire theory. Three centuries before the time assigned by al-Bīrūnī to Nāgārjuna of Daihak, towards 630 A.D. the Chinese pilgrim Hiuan-tsang attests, as a matter of fact, in his *Si-yu-ki*, "Reminiscences of the Western Countries", that at his time the Buddhist chief abbot Nāgārjuna was reputed in India as an alchemist. He took, said Hiuan-tsang, some drugs for augmenting his longevity and would have once changed some stones into gold (trans. Stanislas Julien [in French], Paris, 1859, vol. ii, pp. 98 and 103).

It does not follow that al-Bīrūnī had made a mistake by identifying a relatively recent Nāgārjuna with an important author of Indian alchemy, nor that the Buddhist chief abbot Nāgārjuna had really been a great alchemist. But it follows that one cannot put forward arguments regarding the time when the Nāgārjuna of al-Bīrūnī lived for revoking the doubt about the Indian tradition according to which the chief abbot Nāgārjuna had already practised alchemy and for bringing down the beginnings of Indian alchemy to a later age. The

Nāgārjuna of al-Bīrūnī could only be a homonym of an illustratious personage of whom the reputation of being an alchemist had been made after some countries.

Besides, al-Bīrūnī did not doubt that the origin of Indian alchemy was much more remote than the time of Nāgārjuna mentioned by him. As a matter of fact, he said of another alchemist, Vyāḍi, making him alive at Ujjain at the time of the King Vikramāditya. He distinguished between two kings of this name, the founder of the "Vikrama" era and the vanquisher of the Śaka, himself the founder of the era 137 years later (ii. 6). But he specified, *a propos* of Vyāḍi, that the Vikrama of whom he was contemporary was the founder of the era bearing his name. As he knew the antiquity of this era (57 B.C.), he therefore conceded the seniority of Vyāḍi. Moreover, he did not make Vyāḍi a founder of the science he had cultivated. Indeed he relates a legend according to which Vyāḍi was at first ruined [financially] in vain attempts to realise the prescriptions of an already existing book of alchemy which he had misunderstood. Vyāḍi had interpreted the compound *raktāmala* as signifying "red *(rakta)* myrobalanon *(amala)*" which he should have understood as "human blood and oil", [and] which he would later on recognise accidentally, some drops of his blood having fallen from his head in the cauldron when he was wounded on the head after having been burnt and having the burn oiled. Of course, al-Bīrūnī has not guaranteed the authenticity of the legend, but it suffices us here to state that he has not denounced any anachronism.

As regards the existence of an alchemical author named Vyāḍi we can confirm the information of al-Bīrūnī. Sachau only knew it as the name of a lexicographer (ii. 315). But the Tibetan *bsTan-'gyur* contains the translation of a *Rasasiddha-śāstra*, apparently not preserved in Sanskrit, that is attributed to Vyāḍi and of which an extract was also the object of a Tibetan translation (mDo, cxxiii, 1 and 3, cf. P. Cordier, *Catalogue du fonds tibetain de la Bibliotheque Nationale*, vol. iii, Paris, 1915, p. 473). It has furthermore been pointed out that Vyāḍi is cited as an authority in the *Rasaratna-samuccaya* and the

Rasaratna-pradīpa (cf. G. N. Mukhopādhyāya, *History of Indian Medicine*, vol. iii, Calcutta, 1929, p. 758). G. N. Mukhopādhyāya believes him to be posterior to Pāṇini (identifying him with the grammarian of the same name) and anterior to Nāgārjuna, and places him at the 5th century B.C. We have, however, no evidence that one should identify the alchemist with the grammarian. An indication according to which the latter lived at Vindhya seems to distinguish the same from the alchemist of Ujjain, although the same man could have lived successively in different places. One can rather, but again without decisive evidence, try to identify the alchemist Vyāḍi with the homonymous author of Tantric works that were translated in the *bsTan-'gyur*, rGyud, lxxiv. 34&37 and lxxvi, 29 and 30). Nor can we date him back earlier than the 5th century of our era without contradicting the testimony of the tradition noted by al-Bīrūnī which puts him at the 1st century. It can only be that he was anterior to Nāgārjuna if the tradition be certain, but the attributions of an author to the time of Vikramāditya is a frequent and arbitrary practice (several [men] reputed to be of this time in fact belong to the first centuries of the Christian era and not contemporary to one another). Vyāḍi's name is found just before Nāgārjuna in the list of alchemists that is given at the beginning of *Rasaratna-samuccaya* of Vāgbhaṭa (i. 3) and undoubtedly it is he who again appears under the name of Vyālācārya at the top of a similar list of authors in the same work (vi. 59), where Nāgārjuna occupies the fifth place. But the order adopted in the lists cannot be considered chronological because, for a good number of names, it differs totally from one another (the same names are not all in agreement).

Only a thorough study of Indian alchemical literature, such as Praphulla Chandra Ray had inaugurated, could only elucidate the questions of this sort. Meanwhile, the data of al-Bīrūnī are valuable to us, provided that we compare them with those of other sources. However, the esoteric character of Indian alchemy made these more difficult for al-Bīrūnī to acquire and less reliable than those of other subjects. Al-Bīrūnī

had conceived a contempt for the teachings of this tradition as well which is explained because he had noticed in it only a vain pursuit for wealth and magical power and because it was not possible for him to obtain precise information about the methods employed by them. The chemical part of this tradition, which is not at all without value, has not been introduced to him and he could only know the alchemical part.

This results from the fact that he himself speaks of not being able to determine with certainty if the Indians always worked, above all, on mineral, animal or vegetable matter although it appeared to him that it was mostly with mineral. This also resulted from faulty information that were given to him. It is thus he translates *rasa* by "gold" (Sachau, i. 188) while it concerns either "mercury" or cinnabar, or a whole series of "essential bodies", that is to say, objects found in their native state such as cinnabar *(rasa, daraka, hiṅgula)*, mica *(abhra)*, pyrites *(mākṣika)* etc. ...He also ascribes to *tālaka* (i, 188) the Indian name of talcum (Arabic *tālq*) whereas in Sanskrit *tālaka* means *orpiment* (yellow arsenic) which, it is true, appears in lamina like talcum, but is yellow (cf. *Rasaratna-samuccaya* iii.66ff).

Thus, it is, above all, his testimonies on the Indian legends regarding the alchemists which are useful to us. Other than those [tales] we have cited on Nāgārjuna and on Vyādi, he has preserved for us another one of which an exact parallel is known in Cambodia in the story of the Leprous King of Angkor Thom.

The popular Cambodian tradition indeed tells that the king, invited by a Brāhmaṇa alchemist to plunge in a boiling medicinal bath to cure himself wished that the Brāhmaṇa should take the plunge first. The latter accepted on condition that the king would throw on him a certain powder at the time. The king, after having promised, abstained from throwing the powder, and the Brāhmaṇa died (cf. G. Poree and E. Maspero, *Moeurs et coutumes des Khmers*, Paris, 1938,p.73).

Al-Bīrūnī tells on his side (i. 191) the same incident but with the difference that the king is not leprous. He is invited by an alchemist to take a plunge in boiling oil prepared for

making him immortal, victorious and invincible. He does not dare and accepts that the alchemist would himself take a plunge while he would throw different packets of drugs successively in the bath. But being afraid that the man would arise immortal, victorious and invincible, he abstains from throwing the last packet. The man dies and is found transformed into a lump of silver. The scene is located at Dhāra, the capital of Mālava.

The Indian story of al-Bīrūnī is clearer than the Cambodian parallel where the motive that prevented the king from keeping his promise remains obscure. But it manifestly concerns the same legend, apparently transported from India to Cambodia. Thus, once more, the valuable text of al-Bīrūnī receives an additional interest and range by comparison with the data that are foreign to it.

[Translated from French by Ramkrishna Bhattacharya]

CHEMISTRY IN ANCIENT INDIA[1]

P. C. RAY

I shall endeavour to unfold before you to-day a forgotten chapter in the history of the intellectual development of the Indian people, namely the cultivation of the Experimental Sciences. It is generally taken for granted that the Hindus were a dreamy, mystical people given to metaphysical speculation and spiritual contemplation. Due credit is, no doubt, assigned to them for the production of such priceless treasures as the Upaniṣads, the Six Systems of Philosophy, including the abstruse Sāṃkhya and the *Gītā*, with their transcendental teachings. But the fact that the Hindus had very large hand in the cultivation of the experimental sciences is hardly known in these days.

It should, however, be borne in mind that Experimental Sciences such as we now understand them are of very recent origin and growth, even in Europe.

The controversies of the Schoolmen in the Middle Ages lend colour to the theory that in approaching the discussion of the most evident truths of nature the learned men of Europe always avoided the test of appealing to experiments. As some of you are aware, a solemn discussion arose among the foundation members of the Royal Society as to whether a dead fish weighed more than a live one, though it never occurred to them that the solution of the problems lay in directly weighing a fish—live and dead. When the Royal Society was founded in 1662 by Boyle, Hooke, Christopher Wren and other students of Nature, Hobbes sneered at them as "experimentarians." If such was the respect for accurate knowledge even in England in the 17th century, we should not be justified in applying a rigid test to the knowledge of India in the past ages.

Experiments and observations constitute the fundamental

1. The following is the full text of the address delivered by Dr. Ray before the Madras University in February, 1918.

bases of Sciences. It is naturally a relief to come across such dicta as laid down by two standard works on Hindu Chemistry, namely, *Rasendra-cintāmaṇi* by Rāmacandra, and *Rasa-prakāśa-sudhākara* by Yaśodhara, both belonging to the 13th or 14th century A.D.

Says the former : "That which I have heard of learned men and have read in the Śāstra-s but have not been able to verify by experiment I have discarded. On the other hand those operations which I have according to the directions of my sage teachers, been able to perform with my own hands —those alone I am committing to writing.

"Those are to be regarded as real teachers who can verify by experiments what they teach—those are to be regarded as laudable disciples who can perform what they have learned—teachers and pupils, other than these are mere actors on the stage."

Yaśodhara, the author of the latter, observes : "All the chemical operations described in my book have been performed with my own hands—I am not writing from mere hearsay. Everything related is based upon my own conviction and observations."

The progress of chemical knowledge among the ancient nations has always had a fascination for me. The classical works of Thomson, Hoefer and Kopp have been my favourite companions ever since I was a student at Edinburgh now 35 years ago. In the course of my studies in this field I was naturally led to an inquiry into the exact position which India occupied therein, and with this view I undertook a systematic examination, from the chemical standpoint, of the *Caraka*, the *Suśruta*, and such other standard works of the Āyurvedic and Iatro-Chemical periods as had escaped the ravages of time.

My investigations in this direction naturally brought me into communication with M. Berthelot some twenty-one years ago—a circumstance which proved to be a turning point, if I may say so, in my career as a student of the history of Chemis-

try. The illustrious French savant who was then the recognised leader of the chemical world, who has done more than any other person to clear up the sources and trace the progress of Chemical Science in the West, expressed a strong desire to know all about the contributions of the Hindus, and even went the length of making a personal appeal to me to help him with information on the subject. In response to his sacred call, I submitted to him, in 1898, a short monograph on Indian alchemy based chiefly on *Rasendrasāra-saṃgraha*, a work which I have since then found to be of minor importance and not calculated to throw much light on the vexed question as to the origin of Hindu Chemistry. M. Berthelot not only did me the honour of reviewing it at length but very kindly presented me with a complete set of his monumental work, in three volumes, on the Chemistry of the Middle Ages, dealing chiefly with the Arabic and Syrian contributions on the subject, the very existence of which I was not till then aware of. On perusing the contents of these works I was filled with the ambition of supplementing them with one on Hindu Chemistry.

I confess, when I first entered into the self-imposed task, I was filled with misgivings for I apprehended that the materials were meagre and fragmentary. I set vigorously to the task. As I proceeded with my labour of love I was simply appalled by the number of old, worm-eaten Chemical Manuscripts which began to pour in from every quarter of India—from Madras, Tanjore, Ulwar, Kashmir, Benares, Katmundu (Nepal) and last but not least from Tibet—the *bsTan-'gyur* or the Encylopaedia comprising the wisdom of India—being now accessible to us since the temporary occupation of Lhassa in 1904-05. I was filled with the ecstasy which a prospector feels when he suddenly comes across a vein of precious metal after years of fruitless efforts. The discovery of such unexpected and forgotten mine of wealth amply sustained me during the 12 years of the best period of my life although much difficulty was felt in apportioning my time between the demands of the library and the laboratory. I will now take you over to some of the results of my inquiry.

In the various seats of learning in ancient India, along with other branches of literature and science, medicine also formed an important subject of study. Some 2500 years ago the University of Taxila, of Jīvaka Komāravacca was studying medicine under the sage Ātreya. Now, there is a world of meaning hid under the term "Komāravacca," which is a Pali corruption of the Sanskrit "Kaumārabhṛtya". A student of Āyurveda is well aware that the science of Indian medicine is divided into eight sections of which *kaumārabhṛtya* or treatment of children's diseases is one. Jīvaka afterwards became the celebrated Court Physician to King Bimbisāra of Magadh, a contemporary of Buddha. We have thus historical evidence of the cultivation of Āyurveda in India several centuries before the birth of Christ. Now the branch of science which I have the honour to represent, namely Rasāyana, cannot, however, be traced to such an early date. Strictly speaking, Rasāyana does not mean Chemistry. Its radical meaning is a medicine which promotes longivity, retentive memory, health, virility, etc. (*Caraka*, i. 2. 6); in other words, it is the *Elixir Vitae* of the alchemists of the Middle Ages. Later on, in the Tāntric ages, Rasāyana was almost exclusively applied to the employment of mercury and other metals in medicine and at present it means *alchemy* or *chemistry*. In an alchemical treatise of the 13th or 14th century A. D., the author speaks of his subject as *Rasāyanīvidyā*, *i.e.*, the science of mercury and metals. In the celebrated work called *Rasaratna-samuccaya* (or, A collection of gems of mercury and metals), to which I shall have occasion to refer more than once subsequently, the author begins by offering salutation to 27 adepts or *rasasiddhi-pradāyaka*. The term *rasasiddhi-pradāyaka* is derived from *rasa*, mercury, *siddhi*, accomplishment, and *pradāyaka*, giver or bestower; it therefore means giver of accomplishment in mercurial preparation, *i.e.*, an expert on alchemy. It is necessary to bear in mind that in the standard Āyurvedic works, *e.g.*, *Caraka*, *Suśruta* and *Vāgbhaṭa*, there is scarcely any mention of mercury or its preparations.

Here it is necessary to make a slight digression in order to

realise the impetus which the study of Chemistry received in ancient India. In Europe, in the Middle Ages, chemistry—call it alchemy if you like—made considerable progress chiefly as a handmaid of medicine. In our country, though the pursuit of this science was made an auxiliary to the healing arts, it made rapid strides by entering into an alliance with the Yoga philosophy. According to this system, as you all know, knowledge has to go through seven stages before it is perfect and eight means are prescribed by which this perfect knowledge can be obtained; of these *dhārana* (steadfastness), *dhyāna* (contemplation) and *samādhi* (meditation) are the essential constituents. When these last three are united, *samayama* follows and results in the acquisition of occult powers (or *siddhi*). In later times, the philosophy of the Yoga was pressed into the service of science and degenerated into Tāntrika rites, especially in Bengal.

What is it that made these Tantras the repositories of chemical knowledge ? The answer is given in the words of *Rasārṇava* (lit. sea of mercury) itself, a most authoritative Tāntric work on chemistry, which has been edited in the *Bibliotheca Indica Series* by myself in collaboration with Paṇḍit Hariścandra Kaviratna. This work extols the virtues of mercury and its various preparations. Thus,

"As it is used by the best devotees for the highest end, it is called *pārada* (quicksilver)."

"Begotten of my limbs, it is, O Goddess, equal to me. It is called *rasa* because it is exudation of my body."

"It may be urged that the literal interpretation of these words is incorrect, the liberation in this life being explicable in another manner. This objection is not allowable, liberation being set out in the six systems as subsequent to the death of body, and upon this there can be no reliance and consequently no activity to attain to it free from misgivings. This is also laid down in the same treatise."

"Liberation is declared in the six systems to follow the death of the body."

"Such liberation is not cognised in perception like an emblic

myrobalan fruit in hand."

"Therefore a man should preserve that body by means of mercury and of medicaments."

A few more typical extracts are given below which will throw further light on the subject :

"The body, some one may say, is seen to be perishable, how can then its permanency be effected ? Think not so, it is replied, for though the body, as a complexus of six sheaths or wrappers of the soul, is dissoluble, yet the body as created by Hara and Gaurī under the names of mercury and mica may be perdurable. Thus it is said in the *Rasahṛdaya.*

"Those who without quitting their bodies have attained to new ones through the influence of Hara and Gaurī (mercury and mica), are to be praised as *rasasiddha* (alchemists). All *mantra*-s are at their services."

"The ascetic, therefore, who aspires to liberation in this life, should first make to himself a glorified body. And inasmuch as mercury is produced by the creative conjunction of Hara and Gaurī (and mica is produced from Gaurī), mercury and mica are severally identified with Hara and Gaurī in the verse :

"Mica is thy seed, and mercury is my seed. The combination of the two, O Goddess, is destructive of death and poverty."

"There is very little to say about the matter. In the *Raseśvara-siddhānta*, many among the gods, the Daitya-s, the Muni-s and mankind, are declared to have attained to liberation in this life by acquiring a divine body through the efficacy of quicksilver."

"Certain gods, Maheśa and others, certain Daitya-s, Kāvya (Śukrācārya and others); certain sages (Bālakhilyas and others); certain kings (Someśvara and others); Govinda-Bhāgabata, Govinda-nāyaka, Carvaṭi, Kapila, Vyāli, and others—these alchemists having attained to mercurial bodies and therewith identified are liberated though alive."

Now this alliance between alchemy and the Yoga Philosophy had already become cemented in the 11th century A.D. Thus,

al-Bīrūnī, the celebrated Moslem contemporary of Mahmud of Gazni, who was as much at home in Arabic and Greek as in Sanskrit literature, says :

"The adepts in this art try to keep it concealed, and shrink back from intercourse with those who do not belong to them. Therefore, I have not been able to learn from the Hindus which methods they follow in this science and what element they principally use, whether a mineral or an animal or a vegetable one. I only heard them speaking of the process of sublimation, of calcination, of analysis, and of the waxing of talc, which they call in their language *tālaka*, and so I guess that they incline towards the mineralogical method of alchemy.

"They have a science similar to alchemy which is quite peculiar to them. They call it *Rasāyana.* It means an art which is restricted to certain operations, drugs and compound medicines, most of which are taken from plants. Its principles restore the health of those who were ill beyond hope, and give back youth to fading old age, so that people become again what they were in the age near puberty; white hair becomes black again, the keenness of the senses is restored as well as the capacity for juvenile agility and the life of the people in this world is even extended to a long period. And why not ? Have we not already mentioned on the authority of Patañjali that one of the methods leading to liberation is *Rasāyana*?"

The number of works on alchemy which are connected with the practices of the Tāntric cult is simply legion and they rose to such importance in the 11th to 14th centuries A.D., if not earlier, as to claim a place among the *darśana*-s (philosophies) in vogue at this period. As you all know, the celebrated Mādhavācārya, Prime Minister of King Bukka I, of Vijayanagara, in his treatise on the sixteen systems of philosophy extant in his age—called *Sarvadarśna-saṃgraha,* devotes a chapter to *Raseśvara-darśana* or the "Science of Mercury." In his exposition of the subject the learned Head-Abbot of the Monastery of Śṛṅgerī, not far from the city of Madras, quotes at length from the standard works on Chemistry, notably *Rasārnava, Raseśvara-siddhānta* and *Rasa-hṛdaya* of Govinda-Bhāgabata.

I shall now read one or two extracts from *Rasārṇava* from the chapter dealing with chemical apparatus and the colour of flames and the extraction of the metals from the ores (metallurgy). It is scarcely necessary to remind you that the Tantras are in the shape of Dialogues between the god Śiva and his consort Pārvatī.

ON APPARATUS AND THE COLOUR OF FLAMES

"Śrī Bhairava said : The *rasa*-s, the *uparasa*-s, the metals, a piece of cloth, *bidam*, a pair of bellows, iron implements, stone pestles and mortars, the apparatus known as *koṣṭī*, mouth blowpipe, cow-dung, substantial wood (as fuel), various kinds of earthen and iron apparatus (*e g*., crucibles), a pair of tongs and earthen and iron vessels, weights and balances, bamboo and iron pipes, the fats, the acids, the salts and the alkalis, the poisons—all these are to be collected and chemical operations begun."

EFFICACY OF THE APPARATUS

"For killing and colouring mercury, an apparatus is indeed a power. Without the use of herbs and drugs, mercury can be killed with the aid of an apparatus alone; hence an expert must not disparage the efficacy of the apparatus."

CRUCIBLES

"Earth of black, red, yellow and white colour, burnt husks of paddy, soot, earth from the ant-hill, well-brunt excrements of the goat and the horse, rust of iron" [varying proportions of the above ingredients are used for making crucibles, retorts etc.].

COLOUR OF FLAMES

"Copper yields a blue flame...that of the tin is pigeon-

coloured; that of the lead is pale-tinted...that of the iron is tawny;...that of the "peacock ore" *(sasyaka)* is red."

TESTS OF A PURE METAL

"A pure metal is that which, when melted in a crucible, does not give off sparks nor bubbles, nor spurts, nor emits any sound, nor shows any lines on the surface, but is tranquil like a gem."

COPPER FROM THE PYRITES

"*Mākśika,* repeatedly soaked in honey, oil of *ricinus communis,* urine of the cow, clarified butter, and the extract of the bulbous root of *musa sapientum.* and heated in a crucible, yields an essence in the shape of copper."

EXTRACTION OF ZINC FROM CALAMINE

"*Rasaka,* mixed with wool, lac, *T. Chebula,* and borax and roasted in a covered crucible, yields an essence of the appearance of tin; of this there in no doubt."

Let me now quote one or two extracts from *Rasaratnasamuccaya* or a "thesaurus of gems of mercury and metals." The author gives the following description of initiation of disciples and of a chemical Laboratory :

INITIATION INTO DISCIPLESHIP

"The instructor must be wise, experienced, well-versed in chemical processes, devoted to Śiva and his consort Pārvatī, sober and patient. The pupil should be full of reverence for his teacher, well-behaved, truthful, hard-working, obedient, free from pride and conceit and strong in faith.

"Chemical operations are to be performed under the auspices of a ruler, who is God-fearing, who worships Śiva and

Pārvatī, and whose territory is free from anarchy; and the Laboratory, to be erected in the depth of a forest, should be spacious, furnished with four doors and adorned with the portraits of the Gods.

"Take of gold-leaf 3 *niṣka*-s in weight and quicksilver 9 *niṣka*-s and rub them with acids for 3 hours. Make the amalgam into a *phallus* (emblem of Śiva, the creative principle)...The phallus to be worshipped in due from. By the mere sight of phallus of mercury, the sins accumulated by the killing of 1,000 Brāhmaṇas and 10,000 cows are redeemed.

"The science of mercury was communicated to man by Śiva himself and is to be imparted by the instructor to the disciple according to the prescribed rules with closed eyes.

"The science of mercury is to be strictly kept a secret...If it is divulged, its efficacy is gone."

ON THE LABORATORY

"The Laboratory is to be erected in a region, which abounds in medicinal herbs and wells... It is to be furnished with the various apparatus. The phallus of mercury is to be placed in the east, furnaces to be arranged in south-east, instruments in the south-west... The *koṣṭī* apparatus for the extraction of essences of metals, the water vessels, a pair of bellows and various other instruments are also to be collected as also the threshing and pounding mortars, the pestles, sieves of various degrees of fineness, earth for the crucibles, charcoal, dried cow-dung cakes, retorts made of glass, earth and iron, and conch-shells, iron-pans, etc.

"Those who are truthful, free from temptations, given to the worship of Devas and Brāhmaṇas, self-controlled and used to live upon proper diet and regimen—such are to be engaged in performing chemical operations."

The mercurial and metallic preparations of the Tāntric age began slowly to supplant if not altogether supersede the treat-

ments by the administration of herbs and simples as prescribed in the *Caraka*, *Suśruta*, and *Vāgbhaṭa*, *i.e.*, the genuine Āyurvedic System. Already as early as the 11th century, we find Cakrapāṇi Datta, himself a learned commentator of *Caraka* and *Suśruta* and author of the well-known medical work which goes by his name, not only recommending certain mercurial preparations but taking credit for introducing them. In fact, from the 12th century onwards inorganic (or metallic) remedies rapidly gained in popularity and this circumstance in its turn reacted upon the spirit of the age in giving fresh impetus to the study of Chemistry. I can quote *ad libitum* from the Chemical Tantras of this period, as treasures of all kinds lie scattered in inexhaustible profusion in these works, but I need not tire out your patience by doing so. I hope I have indicated enough to show with what zeal and zest my favourite branch of science was once cultivated in Ancient India : I cannot conclude better than by quoting the apposite words of Bacon :

"We see then how far the monuments of wit and learning are more durable than the monuments of power or of the hands. For have not the verses of Homer continued twenty-five hundred years and more, without the loss of a syllable or letter; during which time infinite palaces, temples, castles, cities have been decayed and demolished ? It is not possible to have the true pictures or statues of Cyrus, Alexander, Caesar, no, nor of the kings or great personages of much later years; for the originals cannot last; and the copies cannot but lose of the life and truth. But the images of men's wits and knowledges remain in books, exempted from the wrong of time and capable of perpetual renovation."

Thus it is that even after a lapse of 7, 8 or 10 centuries, Govinda, Somadeva, Nāgārjuna, Rāmacandra, Svacchanda-Bhairava and others appeal to modern India in eloquent terms from dust-laden shelves and worm-eaten tomes and manuscripts not to give up the pursuit of the Science they so clearly professed. As I find gathered round me the flower of the youth of Madras, may I join in the appeal so eloquently given utterance to by the chemist Nāgārjuna some 1,000 years ago :

"For 12 years I have worshipped in thy temple, O Goddess; if I have been able to propitiate thee, vouchsafe unto me, thy devotee, the rare knowledge of Chemistry." If twelve years was considered as the irreducible minimum of time which an ardent student ought to spend in mastering the intricacies of our science at such a distant date how many years' assiduous devotion is required to master it to-day ? Chemistry is the science *par excellence* which at present determines the fate of nations and the assiduous pursuit of it has given Germany an enviable predominance in world politics. There is, however, such a thing as pursuit of science for its own sake as also misapplication and prostitution of it. A genuine student of science is filled with joy ineffable as he finds that it enables him to unravel the hidden and mysterious laws of nature. If I could for a moment command the organ voice of Milton, I would exclaim that we are of a Nation not slow and dull, but of a quick, ingenions and piercing spirit, acute to invent, subtle and sinewy to discourse, not beneath the reach of any point the highest the human capacity can soar to. Therefore, the students of learning in her deepest science have been so ancient and so eminent among us that writers of a blest judgment have been persuaded that even the School of Pythagoras took the cue from the old Philosophy of this land.

It is not for nothing that this ancient land of ours has been chosen by the all-wise Providence to be the birth-place of a Vālmīki and a Vyāsa, of a Kālidāsa and a Bhavabhūti, of a Śaṃkarācārya and a Rāmānuja, of a Nāgārjuna and a Yaśodhara, of a Varāhamihira and a Bhāskara and last but not least of a Rammohan, a Keshabchandra and a Vivekananda. You, youngmen of the rising generation, will not, I trust, fail to play your part. As in the glorious palmy days of old, so in the days to come, it will depend upon you whether or not our dear Motherland is to hold her head aloft and secure for herself a recognised place in the comity of nations.

ANTIQUITY OF HINDU CHEMISTRY[1]

P. C. RAY

Today's lecture is a natural sequence of the previous one. Very vague notions seemed to prevail even among oriental scholars of repute as regards the origin and antiquity of Hindu Chemistry—indeed many scholars openly expressed doubts as to whether there existed at all such a thing as Hindu Chemistry. Thus, Barth in his *Religions of India* incidentally observes :

"In regard to alchemy, anyhow, in which the Sittars are zealous adepts, they were disciples of the Arabians, although other Śivaites had preceded them in the pursuit of the philosopher's stone. Already, in his exposition of the different doctrines of Śaivas, Sāyaṇa thought he ought to dedicate a special chapter to the *Raseśvara-darśana*, or 'System of Mercury,' a strange amalgamation of Vedāntism and Alchemy. The object contemplated in this system is the transmutation of the body into an incorruptible substance by means of *rasa-pāna*, *i.e.*, the absorption into it of elixirs compounded principally of mercury and mica, that is to say, of the very essential qualities of Śiva and Gaurī, with whom the subject of the operation is thus at length identified. This species of transubstantiation constitutes the *jīvanmukti*, or state of deliverance commencing with this present life, the sole and indispensable condition of salvation. It is clear that the devotional formulae of the Vedānta are here only a sort of jargon under which there lies hid a radically impious doctrine; and it is not less clear that in this doctrine, which had from the fourteenth century produced a rather considerable literature, there is an infusion of Muhammadan ideas. The Arabs of Khalifat had arrived on these shores in the character of travellers or merchants, and had established commercial relations and intercourse with these parts long before the Afgans, Turks or Mongols, their co-religionists, became conquers."

1. This is the second address delivered by Dr. Ray before the Madras University in February 1918.

Burnell, again, under the influence of pre-conceived notions has been led into the same error, namely, that Indian Chemistry owed its origin to the Arabs. Thus, in his *Notice of Sanskrit MSS. in the Tanjore Palace* he draws the conclusion from the colophon at the end of the chemical Tantra, *Rasasāra*, "'I have composed my work after consulting the traditions and opinions of the Baudhas' "—that by Baudhas (Buddhists) the author probably means the Muhammadans." Had Burnell the patience to go over the body of the text of *Rasasāra* he would have been disabused of his sad error, for the author candidly admits that he derived his information from the very fountainhead, namely the Buddhists of Bhoṭ or Tibet. I shall have to say much later on about Bhoṭ being the asylum of chemists. Now, as far as Chemistry and Arithmetic are concerned, the Hindus far from learning anything from the Arabs were their teachers. This is gratefully acknowledged by the Arabian writers themselves of the 10th and 11th century. Any one who is interested in the subject may consult my *History of Hindu Chemistry* in which a chapter has been devoted to the discussion of it. The outstanding feature is that in the reign of the Khalifs Mansur and Harun, Indian paṇḍits went to Bagdad at their invitation and translated the *Caraka, Suśruta* and many other medical treatises.

The preparations of mercury began to be prescribed for external administration as early as the 11th century A.D., if not earlier. Cakrapāṇi prescribes *Rasa-parpaṭikā* (a variety of sulphide of mercury) for chronic diarrhoea, etc., and claims to be its discoverer. In Europe, on the other hand, the discovery of this black sulphide of mercury, called also *Aethiop's Mineral*, is ascribed to Turquet de Mayerne in the beginning of the 17th century. In the European Histories of Chemistry, on the other hand, the credit of being the first to press chemical knowledge into the service of medicine and to introduce the use of the internal administration of mercurial preparations is given to Paracelsus the Great (1493-1531). But the French Parliament and the Faculty of Medicine of Paris interdicted what was regarded as the dangerous innovation of Paracelsus.

The Mussalman Hakims had also a horror of the matellic mercurial drugs of the Hindu Pharmacopoeia. Thus, Taleef Shareef says : "My advice is to have as little to do with these as possible."

All this goes to prove that the Hindus not only did not borrow from the Arabians or from the western sources but were precursors in this field.

It is, however, in the domain of metallurgy, *i. e.*, the extraction of metals from the native ores, that the Hindus made marked progress at an early age. The Indians were noted—in fact their fame had spread far into the West—for their skill in the tempering of steel. The blades of Demascus were held in high esteem and it was from India that the Persians, and through them the Arabs, learnt the secret of the art. The wrought-iron pillar close to Kutub near Delhi which is some 1,500 years old; the huge iron girders at Puri; the ornamental gates of Somnath and the 24 ft. wrought-iron gun at Narwar—are monuments of a by-gone art and bear silent but eloquent testimony to the marvellous metallurgical skill attained by the Hindus. Regarding the Kutub pillar, Ferguson says : "It has not, however, been yet correctly ascertained what its age really is. There is an inscription upon it, but without a date. From the form of its alphabet, Prinsep ascribed it to the 3rd or 4th century; Bhau Daji, on the same evidence, to the end of the 5th or beginning of 6th century. The truth probably lies between the two. Our own conviction is that it belongs to one of the Candra Rājas of the Gupta dynasty, either subsequently to A.D. 363 or A.D. 400."

Another authority says :

"It is well-known by every manufacturer of crucible cast-steel how difficult it is sometimes to get the exact degree of hardness to suit certain purposes, especially with reference to steel for cutting the blades, etc. With the ordinary process endeavours are made to reach the required degree of hardness by selecting such raw materials as on an average have the required contents of carbon in order to correspond with the required degree of hardness as far as possible. The natives

[of India] reached this degree by introducing into their cast-steel an excess of carbon, by taking this excess gradually away afterwards, by means of the slow tempering process, having it thus completely in their power to attain the exact degree by interrupting this de-carbonising process exactly at the proper time in order to cast steel of a quality exactly suitable for the purpose."

The Hindus are also entitled to unique credit of being the first to extract zinc from its ore calamine (Sanskrit : *rasaka*). The process is so circumstantially described in *Rasaratna-samuccaya* and is so highly scientific that it can be quoted almost *verbatim* in any treatise on modern Chemistry. I shall purposely withhold here the technical details, which are reserved for a separate lecture to *bona fide* students of Chemistry to be delivered in the next few days. But I may be permitted to point out that the skill displayed as also the marvellous powers of observation recorded therein extort our wonder and admiration. The exact date of discovery of the Hindu method cannot be ascertained but the description occurs in the chemical treatises of the 12th to 13th century A.D. Roscoe and Scherlemmer observe :

"Libavius was the first to investigate the properties of zinc more exactly, although he was not aware that the metal was derived from the ore known as calamine. He states that a peculiar kind of tin is found in the East Indies called Calaem. Some of this was brought to Holland and came into his hands."

The priority of the Hindus is thus also indirectly admitted. As you are aware the two leading works of our Āyurveda are the *Caraka* and the *Suśruta* and both of them belong to remote antiquity. The latter describes at length the method of preparing alkalies and rendering them caustic by the addition of lime. The nice distinction shown between *mṛdu* (mild) and *tīkṣṇa* (caustic) alkali and the direction given for the preservation of caustic alkali in iron vessels are equally scientific and leave very little to improve upon. It is enough to add here that at the present day caustic alkali is imported in iron drums. The chapter on *Kṣarpaka* (preparation of alkalies) in

Suśruta can well be cited as a proof of the high degree of perfection in scientific pharmacy achieved by the Hindus at an early age. Indeed, M. Berthelot was so much struck with the originality of this process that he goes so far as to suggest that this portion in the *Suśruta* is evidently a recent interpolation inserted into the body of the texts sometime after the Hindus had contact with the European chemists. Now, Cakrapāṇi, whose father was Court Physician to King Nayapāla of the Pāla dynasty of Gauḍa and who thus flourished in the middle of the 11th century, *i.e.*, about the time the battle of Hastings was fought, borrows this portion almost *verbatim* from *Suśruta*. Moreover, in the Pāli ethical romance called *Milinda Pañho* there is mention of the cauterisation of bad wounds by means of caustic alkali. The date of this process can thus be traced to about 140 B.C. So there is not the remotest chance of inspiration from the European chemists.

Let me now proceed with some historical evidences of the age of the chemical Tantras to which I referred in my previous lecture. Mādhava in his summary of the *Raseśvara-darśana* (lit. science of mercury) quotes at length from the *Rasa-hṛdaya* of Govinda whom he speaks of as *Bhagavat* and an ancient teacher. Now the qualifying epithets *bhagavat* as also *prācīna* (ancient) are only applied to venerable Ṛṣi-s of old. A contemporary author is never mentioned in such terms of the deepest reverence. It is therefore evident that during the life-time of Mādhava a halo of antiquity had encircled round the name of Govinda, who must have lived at least four or five centuries before the time of the Prime-Minister of Bukka Rao. In other words, the latest date we can assign to Govinda is 9th or 10th century A.D. Internal evidence also corroborates the view I have taken. I was so fortunate as to be able to procure 3 MSS. of this rare work—one from the India Office, the other from the Library at Katmundu (Nepal) and another from Benares. The last is 386 years old and is of special historical importance; from its colophon we learn that it was written at the request of the King of the Kirātaland, *i.e.*, the region round about modern Bhotan. Our author says, "Bhikṣu Govinda, well versed in

chemical operations and loaded with honours by the King of Kirāta, composed this *Tantra* called *Rasa-hṛdaya*. May Tathāgata (Buddha) pronounce his blessing." The Buddhistic creed of the author is thus revealed. There is a belief current in some parts of the Madras Presidency that our Govinda is no other than the celebrated teacher Śaṃkarācārya and some verses from *Śaṃkara-digvijaya* are cited in support of this view. Apart altogether from the question whether at so early a date the progress of chemical knowledge such as we glean from *Rasa-hṛdaya* had been attained in India, the colophon qouted above would tell against such an hypothesis. We need not seriously discuss whether Śaṃkara, the sturdy champion of Brahminical faith, the mighty dialectician, whose activity was mainly instrumental in sounding the death-knell of Buddhism in India, ever sat at the feet of a Guru of the opposite creed. In 1839 the celebrated Hungarian scholar Csoma de Koros who had spent years in the monasteries of Tibet, created quite a sensation by publishing in the *Asiatic Researches* an analysis of *mDo* or the Sūtra-s from the Tibetan Encyclopaedia, the *bsTan-'gyur*. When the Tibetans embraced the faith of Śākyamuni an intellectual craving was created among them and they were eager to remove their mental barrenness by greedily devouring the contents of the literary and scientific works available in North India. Several eminent Paṇḍits of Bengal visited Tibet at the invitation of its king. Some of the most famous amongst them were Śāntarakṣita, high priest of monastery of Nālandā, Padmasambhaba and the sage Dīpaṃkara Śrījñāna (Atīśa), who later on at the request of King Nayapāla accepted the post of high priest of the monastery of Vikramaśīlā. These scholars took a prominent part in the dissemination of Hindu learning in the Land of Snow. The Sanskrit works were rendered into Tibetan with wonderful fidelity to the original and thus many old Hindu works on literature and science, which at one time were supposed to have been lost, can now be recovered.

In the analysis of Csoma de Koros mention is made of a

work on "quicksilver (mercury), the most powerful tonic for subduing every sickness and for improving the vigour of the body" and of another work "on turning base metals into gold."

Chemistry was vigorously pursued in India during the Mahāyāna phase of activity of Buddhism and a fragmentary work of this period on this subject has been recovered entitled *Rasa-ratnākara* and ascribed to Nāgārjuna. From this priceless treatise we can glean much valuable information about the progress of Chemistry in India before the Muhammadan invasion of North India. I have no time to pursue here the chronological sequence of the various chemical works available now. It will suffice to state that the colleges attached to the monasteries of Nālandā, Vikramaśīlā, Udandapur, etc., and which sometimes contained as many as 10,000 students, were recognised seats of learning and Chemistry was included in the curriculum of studies. The last two monasteries were destroyed by Bakhtiyar Khilji and his hordes, and most of the monks thereof put to the sword, only a few managing to escape. The learned Śākyaśrī fled to Orissa and afterwards to Tibet, Ratnarakṣita to Nepal and Buddhāmṛta and others sought asylum in South India. Many emigrants from Magadha rejoined their brethen in the South and founded colleges on a moderate scale in Vijayanagar, Kalinga and Konkan. It will thus be noted that the scholarly monks of the above monasteries, on their dispersion bore with them their learning in the same manner as the Byzantine Greeks on their expulsion from Constantinople carried with them their intellectual treasures to the Italian cities. In the kingdoms of the Deccan and in Tibet the Buddhist refugees found hospitable asylums just as the Greek scholars did in the Florentine Republic under the Medicis. We have thus a ready explanation of the apparent puzzle as to why Tibet and Vijayanagara—the two kingdoms which were cut off and isolated from the external world—should boast of works on Chemistry—as to why Mādhavācārya should be in a position to quote from these standard authors. Again, if Chemistry were the only branch of science pursued in ancient India a *prima facie* case could be made out that its origin lay outside it

and that it was borrowed by the Hindus; but the capacity of a nation must be judged by what it has independently achieved in the several fields of knowledge and branches of Literature, Mathematics, including Arithmetic and Algebra, Geometry and Astronomy; Phonetics, Philology, Grammar, Law, Philosophy and Theology.

Cantor, the historian of Mathematics, was so much struck with the resemblance between Greek Geometry and the Śulva Sūtra-s that he, as is natural to a European, concluded that they were influenced by the Alexandrian School of Hero (215 B.C.). The Śulva Sūtra-s, however, date from about the 8th century B.C. and Dr. Thibaut has shown that the Geometrical theorem of the 47th proposition, Book I, which tradition ascribes to Pythagoras, was solved by the Hindus at least two centuries earlier, thus confirming the conclusion of V. Schroeder that the Greek philosopher owed his inspiration to India. Nor must we forget that the most scientific grammar that the world has ever produced, with its alphabet based on thoroughly phonetic principles, was composed in India about the 7th or 8th century B.C. As Professor Macdonell remarks, "We, Europeans 2,800 years later, and in a scientific age, still employ an alphabet which is not only inadequate to represent all the sound of our language but even preserve the random order in which vowels and consonants are jumbled up as they were in the Greek adaptation of the primitive Semitic arrangement of 3,000 years ago." Nor is it necessary to point out here that the decimal notation was familiar to the Hindus when the *Vyāsa Bhāṣya* was written, *i.e.*, centuries before the first appearance of the notation in the writings of the Arabs or their Greco-Syrian intermediaries.

I began by quoting the opinions of two Orientalists, namely, Burnell and Barth, both of whom were evidently under the impression that the Chemistry of the Hindus had its origin during their intercourse with the Arabs. Before I conclude let me cite the authority of another Sanskrit scholar, who also hints as much. Thus, Aufrecht in his monumental *Catalogus Catalogorum* (Catalogue of Catalogues) while noticing the MSS.

of *Rasaratna-samuccaya* goes somewhat out of his way in asserting that the 27 chemists to whom invocation is made in the opening lines are mostly *apocryphal.* From what I have said above, it will be abundantly clear that these chemists, far from being mythical, existed in real flesh and blood and that Govinda, Nāgārjuna, Yaśodhara and others included in the list have left imperishable records of their attainments in their works, some of which are fortunately extant.

Gentlemen, one word more and I have done; it is of a personal nature and I hope you will forgive me for referring to it. I confess, as a Hindu, the subject of Hindu Chemistry has always had a fascination for me. But there is another valid reason as to way I threw myself heart and soul into the task of recovering the precious gems bequeathed by our chemical ancestors. It is to an illustrious roll of European scholars begining with Sir William Jones, Colebrooke, Prinsep, Lassen, Burnouff and Csoma de Koros that we are mainly indebted for bringing to light and giving prominence to, the priceless treasures embedded in Sanskrit, Pāli and Tibetan literature. Hindu Chemistry, however, waited long and patiently for an interpreter. I thought I owed a debt to the great nation to which I am proud to belong. Hence it is that I felt it incumbent upon me to dedicate some of the best years of my life to this self-imposed task with what success it is not for me to say. We have no reason to be ashamed of the contributions of the ancient Indians to the science of Chemistry. On the contrary, considering the time and age in which they flourished I am justly proud of them. I implore you to take to its pursuit and I hope that you will justify by your work that you are no unworthy successors of your glorious forefathers in the world of learning.

THE HISTORY OF BOTANY AND ALLIED SCIENCES
(AGRICULTURE, MEDICINE, ARBORI-HORTICULTURE) IN ANCIENT INDIA
(c. 2000 B.C. to 100 A.D.)

G. P. MAJUMDAR

GENERAL INTRODUCTION

In the following pages I have made an endeavour to give an account, very briefly, perhaps inadequately, of the origin and development of Plant Sciences, Botany and the allied Sciences of Medicine, Agriculture and Arbori-Horticulture, in Ancient India. The achievements in the line of Medicine as embodied in the *Caraka-* and *Suśruta-saṃhitā*-s, are well known. The Science of Agriculture whose beginning can be traced to the Mohenjo-Daro period also reached a mature state of development in the Vedic Period. There is a book extant called *Kṛṣi-parāśara* bearing on the subject of Agriculture and there are the sayings of the mythical Khanā full of practical suggestions that are found useful even today. The Science of Arbori-Horticulture was also well developed during this period. All decent houses and palaces of noblemen and kings had pleasure gardens and kitchen gardens attached to them. Public parks and pleasure gardens were provided by Governments, and there were Forest Departments which were placed under expert Forest Officers whose duty it was to develop new plantations, administer forest laws, and in every way accomplish the economic development of the forest resources of the State. (Kauṭilya *Arthaśāstra*, Vātsāyana *Kāmasūtra*, *Śukranīti*, etc.)

The *Vṛkṣāyurveda*, a treatise on Botany, written perhaps somewhere in the pre-Buddhistic period (*Arthaśāstra* refers to it) successfully eluded the search for a copy so long, but a copy of this valuable treatise has recently been discovered though in a somewhat mutilated form. I can only say at this stage

that it is a grand discovery. Its contents have been incorporated in the first part of this article.[1]

I. SCIENCE OF BOTANY IN ANCIENT INDIA

(History of Plant Sciences—Its Genesis and Development up to Ist Century B.C.)

INTRODUCTION

Since Man the Hunter settled down to a pastrol life he became dependent on plants for subsistence, materials for clothing, building and shelter and other essential ingredients of his material comforts. The study of plants and plant-life which formed his immediate environment, came to hold a prominent and foremost place in his life. This utilitarian motive gave the first impetus to the scientific study of plants which formed the basis of other allied sciences, such as, Medidicine, Agriculture, Arbori-Horticulture, etc.

The beginning of this relation batween man and plants can be traced in India to the Pre-historic finds unearthed and discoveredin different parts of India by the Archaeologist. The later Neolithic and Iron Age people were at least partially pastoral and lived in houses, wore clothes and derived their wealth from agriculture, trade and commerce. They were well acquainted with a number of plants and perhaps knew something about their life. But the Indus Valley people were far more civilized, used to live in villages, cities and towns, wore clothes, cultivated crops including wheat, barley, millet, dates, vegetables, melon and other fruits and cotton; worshipped trees, glazed their pottery with the juice of a plant or plants, and painted them with a large number of plant designs. We are justified in believing that they knew quite a lot about the general life-history of plants useful to them, particularly for their successful

1. I take this opportunity of recording my grateful thanks to Dr. A. Wolsky, the Principal Scientific Officer of U.N.E.S.C.O. for South East Asia, Delhi, at whose instance the present articles have been written.

propagation and cultivation, as the plants and plant products formed amongst others the main commodities of their trade and commerce, the principal means of their subsistence, etc. Thus the foundation of the science of plant and plant-life, *i.e.* Botany, was already laid in India at this period.

The Vedic Indians were mainly an agricultural people; agriculture became holy and dignified occupation in Vedic India. They practised medicine, laid out gardens and consecrated them for public use; carried out extensive import and export trade, using wheeled wagons, boats and ships as means of conveyance. The Vedic Indians had good many reasons to acquire working knowledge of plants and plant-life. There are sufficient indications to show that Agriculture, Medicine, Arbori-Horticulture, as individual arts and practices developed to a great extent during the Vedic Period. All these required knowledge of plants and plant-life. At this early stage descriptive Botany and knowledge of rudimentary plant physiology became necessary for successful cultivation and propagation of plants, particularly so when their number became unusually large. In the Vedic literature we find a large number of terms used in the description of plants and plant parts, both external features and internal structures; a definite attempt at classification of plants and evidence that manuring and rotation of crops were practised for the improvement of the fertility of soil and nourishment of plants. Even there is indication in the hymns of the *Ṛgveda* that the Vedic Indians had some knowledge of the manufacture of food. the action of light on the process and storage of energy in the body of the plants—a grest achivement indeed for our ancestors at that remote age !

In the post-Vedic Indian literature there is enough evidence to show that Botany developed as an independent science on which were based the Sciences of Medicine (as embodied in the *Caraka*-and *Suśruta Saṃhitā*-s), Agriculture (as embodied in the *Kṛṣi-parāśara)* and Arbori-Horticulture (as illustrated in the *Upavana-vinoda* as a branch of Botany). This science was known as the Vṛkṣāyurveda also compiled by Parāśara. A copy of this manuscript has recently been discovered and already a notice

has been made at a monthly meeting of the Royal Asiatic Society of Calcutta, by the son of the discoverer.

BOTANY DURING THE VEDIC PERIOD
(c. 2000 B. C. to 800 B. C.)

"Plants, I hail thee ! Divine Mother of mankind." (*Ṛv.*, x.97.4.)

It will be seen that facts in connection with Botany of this period have all been culled from stray references, generally made by way of analogy, in non-botanical texts. Here I have found it convenient to arrange them in a more systematic order as in a modern text book, and we shall proceed in this order: 1. Morphology, 2. Anatomy, 3. Physiology, 4. Taxonomy, 5. Plants and Evolution.

1. *Morphology : External*

Casual references to different parts of a plant body are found scattered throughout the Ṛgvedic hymns (i. 32. 5), but almost a complete enumeration of these parts are made in a hymn of the *Aṭharvaveda* (viii. 7). But a more complete and systematic account of the parts of a plant is given in the *Taittirīya Saṃhitā* (viii. 3. 15. 1), and the *Vājasaneyi Saṃhitā* (xxxi. 28) where it is said : The plants comprise *mūla* (root), the *tula* (shoot), the *kāṇḍa* (stem), the *valsa* (twigs), *puṣpa* (flower) and *phala* (fruits). While trees have in addition *skandha* (corona), *śākhā* (branches) and *parṇa* (leaves). Different kinds of plants are distinguished, namely, *vṛkṣa, vana* and *druma* (trees), *viśākhā* (shrubs with spreading branches), *sasa* (a herb), *aṃśumāli* (a spreading or deliquescent plant), *vratatī* (a climber), *stambinī* (a bushy plant), *pratānavatī* (a creeper), and *alasālā* (those spreading on the ground).

Texture and colour of plants are also noticed. Thus a hairy stem is described as *lomaśa-vasana, hiraṇya-varṇa* when it is golden in colour, *hari* when twany, *aruṇa* when ruddy, *babhru* when brown. Plants with thorns are described as *kaṇṭakī*. A leafless plant is called *karīra*.

There are numerous terms scattered throughout the Vedic literature of a special and general nature to denote a particular kind of plant or plant parts. The above is sufficient indication that the Vedic Indians made a great progress in developing Descriptive Botany.

2. *Internal structure*

Detailed study of internal structure of plants became possible only after the invention of the compound microscope. What we notice here is therefore Gross Anatomy.

In the *Ṛgveda*, *dāru* or the wood is distinguished from the softer outer part of a tree (vi. 3. 4). *Taittirīya Saṃhitā* seperates the outer part into *valka* (outer) and *vakala* (inner) bark (ii. 5. 3. 5, *et seq.*; iii. 7. 4. 2). But the *Bṛhadāraṇyaka Upaniṣad* (iii. 9) gives more information on this subject. The *sakara* (soft tissue next to skin which is *tvak*), *kināṭa* (fibrous tissue in *sakara*), *dāru* (wood) and *majjā* (pith). Thus the internal structure of a stem is distinguished into an outer skin (epidermis and dry bark), and inner wood between which stands a soft tissue, the bast (inner and outer) with strong fibres, the bast fibres. The wood encloses the soft pith.

3. *Physiology of Plants*

The Vedic botanist, if I may call him as such, understood the value of cowdung manure, *karīṣa* and *sakṛt* in the nourishment of plants (*RV.* i. 161.10; *AV.* iii. 3. 4; xix. 31. 3; *Taitt. Sam.*, vii. 1. 19. 3). He also practised "rotation of crops" by fallowing and sowing different crops alternately in the same field (*Taitt. Sam.*, v. 1. 7. 3), to improve the fertility of the soil. Roxburgh believes that for the latter practice the Western World is indebted to India.

Prof. B. Chatterjee traces the knowledge of photosynthesis to a couple of verses in the *Ṛgveda* (viii. 43. 9; ii. 1. 14). He thinks that the Vedic people had some knowledge of the manufacture of food, the action of light on the process and storage

of energy in the body of plants.

The above appears to be supported by the author of the *Bṛhadāraṇyaka Upaniṣad* (iv. 6. 1) when he says that the essence of water is embodied in plants, such as grasses, creepers and the rest; flowers represent the essence of plants and the essence of flowers are the fruits, such as, paddy, wheat and the rest.

The leaves are compared to the pores in the skin of a man by the same author. Knowing the function of the pore in the skin we can firmly assume that plants give off water through the leaves might have been anticipated by the Vedic Botanist.

4. *Classification of Plants*

The *Ṛgveda* divides plants roughly into three broad classes, namely, Vṛṣka-s (trees, i.64. 20; 22), Oṣadhi-s (herbs useful to man, x. 97) and Vīrudh-s (i.67. 9). Plants are further subdivided into Viśākhā (shrubs), Sasa (herbs), Vratatī (climbers), Pratānavatī (creepers) and Alasālā (spreading on the ground). All Grasses are separately classified as Tṛṇa-s *(RV.* i. 161. 1). Flowering plants are Puṣpavatī, and the fruit bearing ones are Phalavatī. Leafless plants are placed under the group, Karīra.

The *Atharvaveda* divides Sasa further into Prastṛṇatī (expanding), Ekaśuṅga (one sheathed or spathed), Aṃsumālī (having many stalks or branches), and Kāṇḍinī (jointed). "The spreading, the bushy, the one spathed, the extending herbs, do I address those (plants) rich in shoots, jointed, that have spreading branches." (*AV.* viii. 7. 4.) [Wilson]

Plant Associations also attracted their notice. We find the term Naḍvalā (the bed of reeds) is used in the description of a locality abounding with that species (*Vāj. Sam.* xxx. 16; *Taitt. Brāhm.* iii. 4. 12. 1). Similarly we find when a place is overgrown with Śipāla (a plant) the locality is described as Śipālya (*Ṣaḍ. Brāhm.* iii. 1; cp. *AV.* vi. 12. 3).

5. *Plants and Evolution*

The Vedic thinkers believed that plants had preceded animals, particularly man, in the scale of arrival of living

beings on earth. This is indicated clearly in a hymn of the *Ṛgveda* (x. 97. 1). Yājñavalkya of the *Bṛhadāraṇyaka Upaniṣad* (iv. 6. 1) gives more details. He says : Earth is the source of this creation, movable and immovable; for it supplies them with the constituents of their body; and water again is the root cause of earth for earth is begotten of water; the essence of water is embodied in plants, such as, grasses, creepers and the rest; flowers represent the essence of plants and the essence of flowers are fruits, etc.

POST-VEDIC DEVELOPMENT
(from 800 B.C. to 100 A.D.)

During the centuries that followed prior to the writing out or the compilation of the *Vṛkṣāyurveda* by Parāśara in about the 1st century B.C. or A.D. (or earlier) the study of Botany in India progressed considerably in connection with the study of allied Sciences, particularly the Science of Medicine. In *Caraka-saṃhitā* (Sūtra., i. 51-52) it is expressly said that the man well acquainted with the names and external features of plants and able to use them properly according to their properties, is to be called an expert physician. This is well illustrated in the test to which Jīvaka was put (see below). Here a brief indication of the progress made during this period in different branches of Botany is given, the facts being collected mostly from non-botanical and medical literature of the period.

The three conditions, namely, the *ṛtu* (proper season), *kṣetra* (good soil) and *ambu* (water), necessary for successful germination of seeds came to be known (*Suśruta-saṃ*. Śārīr., ii. 33). In Guṇaratna's commentary on *Ṣaḍdarśana-samuccaya* (verse 49—a later day treatise), the above conditions are explained and we find it mentioned that seeds of Banyan, Aśvattha and Nimba (as in other cases) sprout during the rainy season (hot months) under the influence of dew and air (Vaṭa-pippala-nimbādināṃ prāvṛḍjaladhara-nināda-śiśira-vāyu-saṃsparśād-aṅkurodbhedaḥ). The term *uttānapada* found mentioned in connection with germination *(aṅkurodbheda)* is also significant,

as during germination it is the *pada* or the root that is seen to come out first.

Descriptive Botany made rapid progress. Epiphytes, parasites, mosses*(śaivāla)*, green algae *(jalanīlī)* and mushrooms *(chatrā, udbhida)* came to be distinguished as separate groups of plants, and their properties studied. The *mūla* or the root was recognised as the most important organ of the rooted plant. Its synonym, the word *pādapa*, at once shows that the main function of the root was known. Different kinds of roots, even the bulbous ones are distinguished. *(Arthaśāstra*, xxiv. Bk. ii)

Tula or *vistāra* (shoot) comprises two parts, namely, *kāṇḍa* (axis) and *parṇa* (leaf). Nodes and internodes, caudex *(sthāṇu)*, branches in descending orders *(śākhā, pratiṣākhā, anuśākhā)*, underground stems *(kāṇḍa)* with garlic as example, are described. The bud is called *pravāla*. *Parṇa* or *patra*, petiolate *(sabṛnta)* and sessile *(abṛntaka)*, number of leaflets in a compound leaf, and their shape used in connection with their description, are noticed. Flowers, unopened and open flower buds, arrangement of flowers on the inflorescence axes, such as *stavaka*, *gucchaka*, *chatrā* (umbel), *śrīhastinī* (helicoid) are known. Sepals, petals, stamens and pollen grains are described but gynoecium does not appear to have been recognised. Fruits, their different kinds, such as, *salāṭu* (green), *kṣīraka* (fleshy) also called *jālaka*, *vāna* (dry), *śimbī* (legume), and others are mentioned. *Vīja*, *vījakoṣa*, *śasya* (endosperm), *vījadala* or *vījapatra* (cotyledons) are used in the description of seeds. The term *vīja* for seed is the most scientific as it is that in which the plant germinates or takes its origin.

Different habits of plants are recognised. Weak plants are called *latā*, *vallī* or *vratatī*; *vallī* twines round the stem or a support; *sakāṇḍa*, *kṣupa*, etc. are used in the description of other types of plants.

In Plant physiology also some progress was made. Importance of roots as organ of absorption is indicated by the use of the term *pādapa* for the rooted plant; that of leaf (green) in the manufacture of food is emphasized. *Circulation of sap* was known for it is described as one of the special features of plants *(utsrot-*

asa stamaḥ prāyā antasparśā viśeṣiṇaḥ—Kaṇāda, *Vaiśeṣika sūtra*, v. 2. 7). Manu describes plants as living beings possessing a sort of dormant or latent consciousness and are capable of pleasure and pain *(antaḥsaṅgā bhavantyete sukhaduḥkha samanvitāḥ)*.

Stages of infancy, youth and age of a plant were noticed. Such conditions as light, food and water necessary for normal growth were well known. The maximum age of a tree is given as ten thousand years, and the causes of death are given as suitable and unsuitable food, accident and disease. The phenomenon of Movements in plants towards what is favourable and away from what is unfavourable, their capacity for sleep by closing up leaves at night, sensitiveness to touch (*lajjālupra-bhṛtīnāṃ hastādisaṃsparśāt patrasaṃkocādika)* and even opening up of flowers at different times of the day are noticed *(padmādināṃ prātarvikasanam. ghosātyakādīpuṣpadīnāṃ ca saṃdhyāyāṃ, kumudi-dināṃ tu candrodaye)*. The idea of Sexuality in plants is vague, but methods of multiplication were well known, such as *mūlaja* (by roots), *vījaruha* (by seeds), *skandhaja* (by cuttings), *skandhe ropaṇīyā* (by grafting), *agravīja* (by apices), *parṇayoṇi* (by leaves) and by other methods.

No reference is found to respiration of plants.

The branch of Plant Ecology developed to a great extent. Lands or regions were divided into three classes, namely, *jāṅgala* (desert), *ānupa* (watery or marshy) and *sādharaṇa* (ordinary), and plants characteristic of each region were mentioned *(Caraka-* and *Suśruta-samhita-*s*)*. The *Arthaśāstra* gives the amount of rain fall (measured by rain gauge) in these regions (chap. xxiv, 117-118).

The Taxonomy or the Systematic Botany also made good progress under two heads : Nomenclature and Classification. Plants were named according to some principles. Sir William Jones remarked, "Linnaeus himself would have adopted them had he known the learned and ancient language of this country." They gave plants two names : one for the identification by common people *(paricaya-jñāpikā saṃjñā)* based on some salient external features, and the other on some medicinal or other properties, called *guṇa-prakāśikā saṃjñā*. Thus the plant

Sesbania is called *vakrapuṣpa* (i.e. with papilionaceous flowers), and *vraṇāri* (foe of boil).

Classification of plants was based upon three distinct principles, namely, *audbhida* (botanical), *virecanādi* (medicinal) and *annapānādi* (dietetic). We are concerned here with the first one only.

Plants were classified according to their habit and texture into *vanaspati*, *vānaspatya*, *oṣadhi*, *viruda*, *latā*, *pratānini* and *vallī* as two kinds of *latā*, *gulma* and *tṛṇa*. Plant families as such were not very distinctly recognised. But allied plants or varieties or even different species were grouped together into what may be called a *genus* based on floral characters. The specific characters were taken primarily from the colour of flowers. Thus the genus *kovidāra* (Bauhinia) includes the white, yellow and the red flowered species. The first one is again divided into two varieties. Similarly *balā* (Sida) includes four species, namely, *balā*, *atibalā*, *mahābalā* and *nāgabalā*.

The idea of the gradual evolution of living beings on earth became an accepted conception with the Indians. It will be interesting to quote a relevant Dialogue of the Buddha regarding the Evolution of the Earth : "...Meanwhile the cooling process goes on. As the juicy earth gradually becomes hardened it loses its flavour and sweet taste, but vegetation, first of low then of higher grade evolves".

The problem of Heredity also came to be considered by our ancestors at this period. The question was first raised and discussed in the *Brāhmaṇa*-s : "How specific characters are transmitted ? Why the offspring is of the same species as the parental organisms ?". *Caraka* and *Suśruta* supply the answer. They hold that "all the organs are potentially present at the same time in the fertilized ovum and unfold in a certain order. As the sprouting bamboo seed contains in miniature the entire structure of the bamboo, as the mango blossom contains the stone, pulp and fibres which appear separated and distinct in the ripe fruit, but through their excessive minuteness are undistinguishable in the blossom, even such is the case with man." *Caraka* further assumes that "the sperm cells of the

male parent contain minute elements derived from each of its organs and tissues." Dr. Seal thinks that Caraka thus anticipated Darwin's "gemmules", and Spencer's "ids".

Plant Pathology also made some progress, but not much. With the exception of blight and mildew affecting cereals and sugarcane mentioned in the *Vinaya* texts, reference is found mostly to pestiferous insects, destruction of crops by poisons, fire, snow, etc. Etiology, diagnosis and treatment of plants in diseases are given. Amongst the remedies suggested, the removal of parts affected and measures to be taken against fresh infection through the wound, etc., are mentioned. The barrenness of plants was regarded as a disease and prescription for its cure suggested.

Even the possibilities of creating new and marvellous species have been mentioned. Finally the study of plant life with reference to its environment was so very intensive that plants were used as indicators in ascertaining the price of things, in economic prediction and as a means of ascertaining the presence of water in a waterless region *(Vannupatha Jātaka)*.

THE VṚKṢĀYURVEDA BY PARĀŚARA, or the SCIENCE OF PLANTS AND PLANT-LIFE

(c. 1st century B. C. or A. D. or earlier ?)

The author of the book, Parāśara, was a contemporary of Agniveśa (whose date may be fixed somewhere in the pre-Buddhistic era according to Ray). He wrote or compiled the treatise at the request of the sages assembled at a conference "to give an account of the herbs and plants beneficial to the mankind." This treatise was made the basis of botanical teaching preparatory to medical studies in ancient days, as more Botany is done in modern times. As an illustration may be cited the test to which the celebrated Jīvaka was put at the final examination at the University of Taxilā, for his proficiency in medicine. In the course of examination he was asked "to collect, describe, identify and mention the properties of plants that were to be found within four *yojana*-s of the University town, and this

Jīvaka did to the entire satisfaction of his teacher".

CONTENTS OF THE *VṚKṢĀYURVEDA*

The whole work is divided into six parts, namely; 1. *Bījotpatti-kāṇḍa* : 2. *Vānaspatya-kāṇḍa*; 3. *Gulma-Kṣupa-kāṇḍa*; 4. *Vanaspati-kāṇḍa*; 5. *Virudha-vallī-kāṇḍa*; and 6. *Cikitsitā·kāṇḍa.*

The first part, *Bījotpatti-kāṇḍa,* is again sub-divided into eight chapters, namely, 1. *Bījotpatti-sūtrīyādhyāya*; 2. *Bhūmi-vargādhyāya*; 3. *Vana-vargādhyāya*; 4. *Vṛkṣāṅga-sūtrīyādhyāya*; 5. *Puṣpāṅga-sūtriyādhyāya*; 6. *Phalāṅga-sūtrīyādhyāya*; 7. *Aṣṭāṅga-sūtrīyādhyāya*; and 8. *Dviganīyādhyāya.*

The first chapter begins with the narrating of the occasion for the writing out of the treatise. Then Parāśara discourses on the origin of the first organic being *(ādibījam)* on the earth in the following *śloka* : *Apohi kalalam bhūtvā yatpiṇḍasthāṇukam bhavet tadevaṃ vyuhamānatvāt bījatvam adhigacchati.*[2]

He then gives an outline of the morphology of plant members *(vṛkṣāṅgāni)* : leaves *(patram)*, flowers *(puṣpam)*, roots *(mūlam)*, bark including the vascular system *(tvak)*; stem *(kāṇḍam)*, heartwood *(sāram)*, sap *(sarasam)*, excretions *(niryāsa)*, spines and prickles, i.e., emergences *(kaṇṭakam)*, seeds *(bījam)* and shoots *(praroham)*. He also remarked that from the resemblances and differences in the characters of these plant members the classification of plant groups is possible.

The second chapter, *Bhūmi-vargādhyāya,* deals with the soil. It is clearly pointed out that the adaptability or growing capacity of a plant depends upon the nature and properties of the soil.

2. Mr. Sarkar, the owner of the mauscript, translates the passage thus : "Water transforms into a jelly like substance *(kalalam)* in which the nucleus *(piṇḍasthāṇukam)* is formed, which in course of time being regulated by terrestrial energies *(vyuhamānatvāt)* is converted into a germ *(ādibījam-bījatvam)*." Here, Mr. Sarkar says, we find a clue to the answer of the long standing problem, namely the origin of the first organic body, the protoplasm *(ādibījam)* containing a nucleus (life) on the Earth. The same question has been referred to in non-scientific texts. such as the Vedas, the Upaniṣads, and others.

In the third chapter, *Vana-vargādhyāya,* names, descriptions and distribution of forests, 14 in number, all over India are given.

The fourth chapter, *Vṛkṣāṅga-sūtrīyādhyāya,* deals with the morphology of plant members in detail. Leaves receive the best attention even with regard to its function which is described as : *patrāṇi tu vātātapa rañjakāni abhigṛnhanti,* etc. Parāśara knew that green leaves take up air, heat, light and some colorific principle for the healthy growth of the plant.

The leaf insertion *(vṛnta-bandhanam)*, and phyllotaxis *(patra-bandhanam)*, and their various types have been described exhaustively. The shapes of the leaves have been named and described after articles of common use.

According to the nature of the venation *(śirā-sanniveśa)* two major types of leaves have been distinguished, namely, 1. *Mauñja-parṇa* in which the veins are parallel, the venation being called *praguṇa,* i.e. parallel; and 2. *Jālika-parṇa,* in which the veins are arranged reticulately, and the venation is called *vellita,* i.e. reticulate. Parāśara says that the *praguṇa* and *vellita* venations are characteristic respectively of *Ekamātṛkabīja* (Monocotyledons) and *Dvimātṛkabīja* (Dicotyledons).

The fifth chapter, *Puṣpāṅga-sūtrīyādhyāya,* deals with the flower and its different members and their functions. According to the formation of the thalamus *(sthālakam)* and its relation to the insertions of the floral members, particularly of the gynoecium *(bījādhāram)* flowers have been classified into four distinct types under the heading *puṣpamaṇḍala.* They are : *tunda-puṣpamaṇḍala, kumbha-puṣpamaṇḍala, tuṅga-puṣpamaṇḍala,* and *vāṭyā-puṣpamaṇḍala.* The first is a typical flower and hypogynous, the second is called *puṣpaśīrṣaka.* i.e. epigynous, the *tuṅga-puṣpamaṇḍala* flowers are perigynous, and the *vāṭyā-puṣpamaṇḍala* flower is characteristic of the family Malvaceae. Parāśara named the whole family of Malvaceae on this character alone and named it *vāṭyā-puṣpagaṇa.* Two other types of flowers are also described in addition, and they are : *kuṇḍa puṣpamaṇḍala* and *miśra-puṣpamaṇḍala.*

The sixth chapter, *Phalāṅga-sūtrīyādhyāya*, deals with fruits. Their definition, function and classification have been described quite exhaustively in this chapter.

In the seventh chapter, *Aṣṭāṅga-sūtrīyādhyāya*, the description of the roots, stem, bark, heartwood, sap or juice, excretions, oleaginous products *(sneha)* and spines and prickles, known collectively as *aṣṭāṅga* (8 plant products) have been described in detail.

The eighth or last chapter, *Dviganīyādhyāya*, deals with the seeds and the embryonic plants. Seeds have been classified according to the number of cotyledons *(bījamātṛka)* into two groups : *ekamātṛkabīja* (seeds having one cotyledon) and *dvimātṛkabīja* (with two cotyledons).

At another place he explains the parts of a seed thus : *bījamātṛkā tu bījaśasyam. bījapatrastu bījamātṛkāyām adhyastham ādipatrañca. mātṛkācchadastu tanupatrakavat mātṛkācchadanañca kañcukamityā cakṣate. bījantu prakṛtyā dvividham bhavati. ekamātṛkaṃ dvimatṛkañca. tatraika patra prarohāṇāṃ vṛkṣāṇāṃ bījamekamātṛkaṃ bhavati, dvipatraprarohaṇāntu dvimātṛkāñca.*

Then he describes the function of the parts of a seed during germination thus : *aṅkura nirbitte bījamātṛkāyā rasaḥ saṃplavate prarohāṅgeṣu. tenaiva rasena prarohaḥ snihyate vardhate ca yāvanmūlam na svatantra vṛittiḥ syāt. yadā prarohaḥ svātantryena bhūmyāḥ pārthivarasaṃ gṛṇhāti tadā bījamātṛkā praśoṣamāpadyate.*

INTERNAL STRUCTURE OF LEAF AND STEM

In describing the internal structure of a leaf, Parāśara says that there are innumerable cells *(rasakoṣa)* in a leaf. They serve as the store house of sap *(rasasyāśraya ādhāraśca)* that has got all the elementary properties *(pāñca-bhautikaguṇa)* derived from the earth (and brought to the leaves). These cells which contain colorific principles *(rañjakayuktam)* have got cell-wall *(kalāveṣṭitam)*, and are of microscopic size *(aṇavaśca)*. The cell-wall is a fine membrane *(patrakā)* transformed from protoplasmic substance *(kalalādupajāyate)* by the terrestrial energies *(bhūtoṣmāpācitā)* acting upon it.

For the transport of the watery substances through the body of the plant there are transporting systems *(sarvasrotāṃsi)*. Of these the one that carries the *rasa (rasavaha-srota*—transpiration current) from the earth *(pṛthivyā)* to various plant members is called *syandanī*, and the one that distributes it in the leaf *sirājālāni*. Through this transporting system plants get nutrition and growth becomes possible. These conducting systems have got both upward and downward routes *(sirābhiścopaśarpayanti apasarpayanti ca)*.

FOOD MANUFACTURE IN LEAVES

The soil solution *(pārthiva rasaḥ)* is being transported from the roots to the leaves by the *syandanī*-s. There it is being digested with the help of chlorophyll *(rañjakena pacyamānāt)* into nutritive substances and bye products *(malam)*. The latter while excreted is being attended with the production of heat. The end product of the whole process is being utilised for the growth and development of the plant.

Parāśara could not have described the anatomy and physiology of the green leaf without the help of some magnifying apparatus. We have discussed this question in connection with the History of Medical Science in India.

CLASSIFICATION OF PLANTS *(Gaṇavibhāga)*

The key-note of the Parāśarian system of Classification is based upon the study of comparative morphology of plants, particularly of the floral characters, their resemblances and differences. Only a few Families *(gaṇa*-s) are described here as examples.

1. *Śamīgaṇīyam (Leguminoseae)*

Flowers of *Śamīgaṇa* are generally hypogynous *(puṣpakrāntabījādhāra)*, with 5 petals of different sizes and a gamosepalous calyx *(yuktajālaka)*, 10 stamens *(keśarāḥ)*; fruit *śimbīphalam*, i.e. a legume formed of ripened ovary with seeds on the side *(pārśva-*

bījā). The whole family is divided into three sub-families, namely, *vakra-puṣpam*, *vikarṇika-puṣpam*, and *śuka-puṣpam* according to differences in floral characters. Parāśara describes *śamīvṛkṣa* as having *śimbīphalam*, i.e. a legume or a pod. Its leaves (leaflets) are borne on a comman stalk and are called *śimbī-parṇa* and *puṅkha-parṇa*, i.e. leaflets arranged like a feather; its flowers open by day *(ravikāntā)* as opposed to *candrakāntā*; *śamīvṛkṣa* grows in *jāṅgala* region (tracts having less water). The three sub-families are diagnosed as follows :

Vakra-puṣpam : Flowers hypogynous *(tundamaṇḍala)*, gamosepalous calyx of 5 sepals; petals 5, irregular in size *(viṣama-dalam)*, obliquely inserted, free; stamens 10, 9 united, one free; fruits are legume *(śimbīphalam)* having seeds on one side of the fruit *(pārśvabījam samanvitam)*. Cp. Papilionaceae.

Vikarṇika-puṣpam : Flowers hypogynous having petals and stamens of unequal numbers, calyx gamosepalous, sepals 5; petals are free but irregular; all the 10 stamens are free, rarely stamens 5. Cp. Caesalpineae.

Śuka-puṣpam : Flowers having hairy petals and stamens. Cp. Mimoseae (?).

2. *Svastikā-gaṇīyam (Cruciferae)*

Flowers with superior ovary *(tundamaṇḍalam)*, inflorescence is formed of flowers arranged in rows *(paṃktikrameṇa)*. The calyx *(jālaka)* which is caducous *(puṣpānta)* looks like a *svastikā*, hence the name of the family. Free sepals 4, free petals 4, stamens are free and 6 in number, two of which are shorter *(dvau kharva-keśarau)*. Two carpels are united and form into a two locular *(dvipuṭam)* fruit. The fruit wall *(phala-valkalam)* is sutured and looks like a leguminous fruit *(sadṛśaṃ śamīphalena sandhitaṃ phalavalkalam)*.

3. *Tripuṣagaṇīyam (Cucurbitaceae)*

Flowers are epigynous *(kumbhamaṇḍala)*, sometimes unisexual *(niṣphalapuṣpam)* borne on inflorescence of different kinds *(miśraballarikā)*, and sometimes formed in the axils of leaves; sepals 5, petals 5, united; stamens 3 in number; style with 3 heads

(triśīrṣavarātena); trilocular *(trivartakaiḥ)* ovary with three rows of ovules *(tripuṣaiḥ)* which develop into numerous seeds.[3]

II. SCIENCE OF MEDICINE

Caraka has given[4] a beautiful anecdote about the origin of the Science of Medicine in Ancient India. During the early phase of Aryan Civilization in India diseases were not so prevalent. People in those days lived for hundred years *(śatāyu)* in peace and contentment observing fasts, rites and ceremonies, practising continence, studying the Vedas and worshipping God. But such a happy state did not last long. As time wore on and people became indiscriminate in their food and grew intemperate in habits they became weak in body, and gradually diseases, the bane of longivity and peaceful avocations, appeared on earth and people began to die untimely.

The holy and benevolent *ṛṣi*-s (sages) were moved at the sight of men being thus afflicted with diseases. Out of pity for humanity Aṅgira, Agniveśa, Vaśiṣṭha and other omniscient sages assembled at a certain holy secluded spot at the foot of the Himalayas to devise ways to save mankind from premature death. The theme of their discussion was : Sound health is the only thing which helps man to attain religious merit, wealth, fulfilment of desires and of salvation *(dharma, artha, kāma* and *mokṣa)*; diseases rob him of his health which helps in the acquirement of the said four meritorious deeds, and lastly his life. This prevalence of disease is the greatest obstacle to

3. It is a great work and is sure to excite admiration that such a work could be produced at such a remote period "far distant from the era of the birth of the modern scientific world."
4. It is not possible for me to give a connected story of the genesis and development of the Science of Medicine in Ancient India during the period 2000 B.C. to 100 A.D., but an attempt is made here to give an account of the Science from the genesis traced in the verses of the *Ṛgveda* down to its culmination in the monumental treatises of Caraka and Suśruta. Some outstanding achievements in this connection have also been recorded without any chronology.

human progress. How to allay it ?

It was decided in the Conference that to conquer diseases *sādhanā* was needed and that mankind must be saved from premature death. It was also decided in this great Conference that such remedies would have to be discovered as would not only cure diseases but will prolong youth, strengthen mind and body and increase intelligence (*Caraka-saṃhitā*, i.6; *Suśruta-saṃhitā*, i.1.10). Such is the outstanding feature of the Āyurveda. The authors of the Hindu System of Medicine have not only found out preventives for diseases but have also discovered remedies for attainment of long and healthy life.

Of the sages assembled Agniveśa was the most intelligent and talented. He had all the qualities which tend to success. It is said that the Gods of wisdom, intellect, success, memory, patience, fame, tolerance and pity possessed Agniveśa and the other sages while they were engaged in their *sādhanā*. It is not known how long Agniveśa spent his life in this *sādhanā* ; nor is it known if he had any laboratory for his research. Be it by Divine inspiration or be it by any other means the day when he published the Āyurveda (The Science of Life) the balmy breeze blew from all directions, the quarters of the globe glowed with the radiant sweet scented flowers of charming hues, and dewy flowers rained from Heaven.

Caraka has attempted in the Introduction to his Saṃhitā to impress that success will follow him in his *sādhanā* who has clear and piercing wit, strong determination, memory, intellect and perseverance, who can overlook the ridicule and apathy shown to him, whose pity is boundless, whose heart melts at the sight of suffering humanity, he alone will attain success in his *sādhanā* or quest.

BEGINNINGS OF THE MEDICAL SCIENCE

The Vedic Texts reveal to us the science in its rudimentary stage, while the *Caraka-* and *Suśruta-saṃhitā*-s exhibit it in its full-fledged development, its practical consummation. We have no materials sufficient to show us in detail the processes through

which the transition from the rudimentary stage of the science of which we get a picture in the *Atharvaveda* to the stage of its final development which we see in the *Caraka* and *Suśruta* took place, and we are left to vague conjectures and inferences. Only a hypothetical attempt based on warrantable evidences is made here.

The first medical utterance of man is to be found in a Text of the *Ṛgveda (RV.* x. 97. 2*)*[5], where one hundred and seven applications of the brown tinted plants are mentioned. But the number should not be taken literally but as vague statement of plurality. Some of the hymns are quoted below.

"Mother (of mankind), hundred are your applications, a thousandfold is your growth; to you who fulfil a hundred functions make this my people free from disease [2];

"From him, O Plants ! in whom you creep from limb to limb, from joint to joint, you drive away diseases like a mighty (prince), stationed in the midst of his host [12];

"The plants falling from heaven said : The man whom living we pervade will not perish". [17].

The author of the hymn is a physician *(bhiṣaj)*, son of Atharva. In the 22 stanzas of this hymn he refers to innumerable applications of plants as powerful agencies of cure against diseases. We are told that plants are applied as medicines both individually and collectively against diseases natural and supernatural, against bodily infirmities as well as against curses and the like. The physician used to visit his patients with medicines in boxes made of Aśvattha and Palāśa wood. The genesis of the whole body of medicine is given as Divine and the nature of the cure is clearly characterised as radical, permanent and comprehensive though the details are lacking. Behind the wealth of poetry we get some solid facts of scientific importance. The whole thing has the air of a mere summary distinctly presupposing more elaborate statements, a knowledge of details. Where are the details gone ? They are either lost

5. English translations are from Wilson's edition : vol. vi. p. 276, etc. For details see Majumdar, *Vanaspati*, 1927. pp. 149-184.

altogether to all intents and purposes or they existed in popular memory and were handed down by tradition from generation to generation till at last they came to be synoptically recorded in the Vedic texts quoted above.

But we have a harvest of details bearing upon the subject of medicinal plants, their utilities, their classifications, the diseases against which they are applied, the association in which they are to be applied and the rest, in the texts of the *Atharvaveda*. These details seem to be an elaboration of what we get in a synoptical form in the hymns of *Ṛgveda* (vii. 18; x. 97; x.145).

MALADIES, THEIR CLASSIFICATIONS AND REMEDIES (*Atharvaveda*)[6]

Plants against each of the maladies enumerated below are mentioned together with their applications. In almost all cases plants as drugs have to be used in association with some incantations or invocations of the Divine. The diseases were never thought to be pure affairs of the body and their cure to be perfect and radical had to be both bodily and spiritual.

1. *Physical maladies*

The physical maladies against which cure is provided are : obstruction of urine (i. 3); white leprosy (i. 23); abortion (ii. 25); head disease, evil of the eye, against fever and other maladies (v. 4); against disease *takman* (xix. 39), and injury and diseases in general (i. 2). The medicinal plants identified with their modern representatives are : Reeds, Haridrā, Kuṣṭha, Citraparṇī, Māśaparṇī, Takṣmaṇ, Putrajani, Putrakandā and Putrada.

2. *Supernatural maladies*

As the title indicates, remedies of supernatural diseases were exclusively directed against supernatural agencies, such as

6. English translation by Whitney, Harvard Oriental Series, vols. 7 & 8.

demons, yakṣmas, ghosts, the curses of gods and the like. Plants used as drugs were sometimes applied by themselves and sometimes in association with incantations, invocations and magical formulae. Remedies prescribed are against curse and cursers (ii. 7); against various evils (iv. 7); against witchcraft (ii. 18); possession by evil spirits (ii. 37); exorcism (v. 15); to discover sorcerers (iv. 20); for relief from yakṣma (vi. 85); and for some one's restoration to health (viii. 7). All the plants prescribed are not unfortunately named, only a few can be identified with their modern representatives, and they are Durvā, Apāmārga, Aśvattha, Banyan, Ajaśṛṅgī, Avaka, Varaṇā, Sahadevī, Sadampuṣpa, etc.

3. *Plants that help in the procreation and protection of children*

It is a matter of unique pride that procreation and preservation of children received consideration of the ancient mind. Side by side with procreation had to be considered the hindrances, natural and supernatural, and consequently the requisite remedies.

The plants used for these purposes are : the white and yellow Mustard plants, and they are prescribed against abortion (ii. 25); for fecundity "to procure the conception of male offspring" (iii. 23); and to guard a pregnant woman from demons (vii. 6).

4. *Plants used for curing wounds*

The hymns are very few in number, but they are enough to show that the first surgeons of India, for so we must call them, knew a good deal of human anatomy, displayed a good deal of skill in prescribing remedies according to the nature of wounds. They also appear to be acquainted with a process of classification of plants. The hymns bearing on the subject are : iv. 12; v. 5; vi. 109, and the plants prescribed as relieving drugs are : Arundhatī (Silācī), Plakṣa, Khadira, Dhava, Nyagrodha, Parṇa and Pippalī.

5. *Plants used against venom of snakes and insects*

Medicines were also provided for the treatment of snake bites, etc. The kind of snakes from which men were in constant apprehension of danger are distinctly mentioned. The germ of snake worship may be traced to one of the verses. One of the verses again shows that the Vedic physician knew the physiological fact that the heart is the centre of all vital activities. The hymns referred to are : v. 13; vii. 56; x. 4. Plants are : Mudhūka, Madhuga.

6. *For securing prosperity and prolongation of life with plants*

The Vedic physician took into account man not only in a state of disease but also in a state of health. They devoted their attention to find remedies not only to granting security to life but also to the prolongation of life. The most important plants used are : Aparājitā, Parṇa, Palāśa, Aśvattha, Tāliśa, Pāṭhā, Svadhā, Khadira and Śiṃśapā.

Prosperity is also sought to be brought about by the defeat of foes. The following hymns illustrate our remarks : ii. 27; iii. 5. 6; vi. 15, 96, 129.

7. *Plants used for virility and erotic success*

Medicines were also found out and prescribed both for increasing man's virility on the one hand, and for impairing the virility of opponents on the other. Very allied to the problem of virility is the problem of amatory success, and we find a large number of plants such as Madhūka, Yaṣṭimadhu, Pāṭhā, Vānaparṇī, Kapitthaka, Arka, Candā and Śaṅkhapuṣpikā (hemp) prescribed for the purpose. The hymns concerned are : i. 34; iii. 18; iv. 4; vi. 72, 107, 138, 139 and vii. 38.

8. *Miscellaneous uses of plants* : Items are many :

(i) *Utility of plants to promote growth of hairs.* It is surprising that even in its infancy the medical science (?) in India took note of the importance of the cosmetic considerations for the purpose of the improvement of appearance. Hymns vi. 30, 136 and 137 mention Śamī as the plant

to be used for contributing to the preservation, growth, development and nicety of hairs.

(ii) *Plant amulets for various purposes.* Amulet of Varaṇa (x. 3) is recommended to be worn for the prevention of injury to body, atonement of hereditary sins, warding off foes, and the attainment of prosperity. Amulet of Darbha (xix. 28-33) is used for the purpose of the prolongation of life, for protection, for warding off enemies and for a variety of material blessings. An amulet of Udumbara (xix. 21) assures blessings of progeny, material prosperity, protection against enemy, and lordship over men and other animals. The plant Jaṅgida (xix. 34.35), Satavāra (36) and Guggula (38) are mentioned as remedies against diseases and for protection against witchcraft and for various other blessings.

Evidently a long period must have elapsed between the rudimentary Science of Medicine gleaned out of the Vedic texts as shown above and scientifically written works of Caraka and Suśruta. From the statements of the latter authors it is clear beyond all possibility of doubt that there must have existed a treatise or treatises of the name marking the intermediate period of transition between the Vedas on the one hand, and the *Carakas* and *Suśruta* on the other. Without the hypothesis of the existence of such a work the unbridgeable gulf—a gulf of probably a thousand years or more according to Dr. P.C. Ray *(Hist. of Hindu Chemistry,* [1902], I, p. vii*)*—cannot be explained.

In any case the Ātharvanic origin of the Āyurveda, the Indian Science of Medicine, seems to be warranted by facts. Caraka (i. 30. 8-9) appears to be decisive on the point. Suśruta (i. 1. 3) coming after Caraka precisely agrees with the former in describing the same origin of the Āyurveda.

The major divisions of the Science of Medicine as occurring in the two treatises, the *Caraka-* and *Suśruta-saṃhitā*-s, are as follows :

1. Kāyacikitsā *(Treatment of physical maladies)*; 2. Bhūtavidyā *(Demonology)*; 3. Kaumārabhṛtya *(Science of paediatrics)*;

4. Śalyavidyā *(Surgery)*; 5. Agadatantra *(Toxicology)*; 6. Vājīkaraṇa *(Science of aphrodisiacs)*; and 7. Rasāyana *(Science that treats of prolonging life)*.

And these precisely correspond to the divisions of this Science in its rudimentary stage as we have deduced above from the hymns of the *Atharvaveda*.

SOME OUTSTANDING ACHIEVEMENTS DURING THIS PERIOD (c. 2000 B. C. to 100 A.D.)

1. *Circulation of Blood*

Harvey independently discovered the system of the circulation of blood and nobody should grudge him the honour he rightly deserves. But long before him the Vedic physicians knew the physiological fact that the heart is the centre of all vital activities *(AV.* x. 4. 25*)*. *Caraka*[7], however, elaborates the function of the heart and gives the following description of the circulation of blood : From that great centre (the heart) emanate the vessels carrying blood into all parts of the body; the element which nourishes the life of all animals and without which life would be extinct. It is that element which goes to nourish the foetus in uterus and which flowing into its body returns to the mother's heart. In the *Bhāvaprakāśa* (of much later date) the following passage occurs : *dhātunām pūraṇam samyak sparśajñānam asaṃśayam. svaśirāsucaradraktam kuryāccānyān guṇān api yadātu kupitaṃ raktaṃ secate svacchā siraḥ tadāsya vividhā rogā jāyante raktasambhavāḥ.* Long before it in the *Hārita-saṃhitā* the circulation of the blood has been mentioned while dealing with the disease of Jaundice *(Pāṇḍu-roga)*.

2. *Surgical requisite* : *Anaesthetics*

Of the different kinds of operations mentioned in the *Suśruta* there are some which cannot be performed without the patients being made unconscious. In the *Bhojaprabandha* of Paṇḍita Ballāla there is mentioned the use of anaesthetic drugs during

7. *Caraka-saṃhitā*, Sūtra, xxx.

operations. The *Bhojaprabandha* is a collection of some stories from the life of King Bhoja. At one time the king was suffering from excruciating pain in the head and the use of all sorts of anodynes failed to relieve his pain which rather gradually increased. Now came to his capital two brothers both of whom were expert surgeons. When called to treat the king they said that he could be cured only by operation. The king having agreed to undergo the operation, they made him unconscious by an anaesthetic drug called *sammohinī*, trephined the skull, removed the deceased portion of the brain, stitched the wound and applied a healing balm to the wound. They then administered a restorative drug known as *sañjīvanī* to the patient who thereupon regained consciousness and felt better.[8] Such surgical operations were done alse during the time of the Buddha. Seal quotes two powders which the Hindu chemists of old could prepare, namely, *yoga-cūrṇa* (in *Daśakumāracarita)*, and the other *stambhana-cūrṇa* (in *Vāsavadattā)*. The inhalation of the former would bring on sleep or stupor, and of the other would paralyze sensory or motor organs in the subject.[9]

3. *Microbes : Pathogenic*

The bacterial origin and the infective nature of certain diseases such as the eruptive fevers, leprosy, small pox, tuberculosis, etc. have been clearly indicated in such passages as these :

"All forms of leprosy (and some skin diseases) are due not only to the derangements of *vāyu*, *pitta* and *kapha* but also to microbes" (*Suśruta*, Nidāna, v).

"Various skin diseases and leprosy, fever, pulmonary consumption, opthalmia and diseases borne by air and water are usually capable of transmission from one man to another" *(Ibid*, v)[10]

8. See *Short History of Aryan Medical Science* by Thakur Saheb of Gondal. *Suśruta-saṃhitā*, vol. I. Intro., p. xii-xiii. Eng. translation by K. L. Bhisagratna.
9. *Positive Sciences of Ancient Hindus*, Lond., 1915.
10. Gananath Sen, *The Spirit and Culture of Āyurveda*, in *The Cultural Heritage of India*, vol. III.

4. *Magnifying apparatus*

Suśruta (Uttara, liv) described the presence of blood corpuscles which circulate in blood and are invisible to the naked eye. MM. Gananath Sen concluded that they had some means of magnifying considerably objects invisible to the naked eye[11]. But Dr. Ravivarma[12] gives a more detailed account of this knowledge given in the *Caraka-saṃhitā*. He says : From some of the descriptions (given by Caraka) it is certain that they must have had some means of magnifying considerably to make invisible objects visible to the naked eye, in short, some form of magnifying apparatus. Without such an aid how could they have described the blood corpuscles? Caraka's description of *kṛmi*-s of blood will mean nothing if it is not the description of the corpuscules. Caraka says they arise by budding *(śoṇitajānāṃ tu kuṣṭhaḥ sabānaṃ samutthānam)*, they are unicellular structures *(aṇavaḥ)*, circular or disc like *(vṛttāḥ)*, without feet *(apādāḥ)*, invisible on account of extreme fineness *(sūkṣmatvāñcaika bhavantādṛsyāḥ)*, of coppery colour *(varṇa tāmra)* etc. This description shows conclusively that they had some means of magnification, otherwise how can they ever say that a certain thing is invisible on account of its extreme fineness, and directly proceed to describe its form, colour, etc.

5. *Hospital and its requisites*

Corresponding to the Sanskrit *ārogyaśālā* ("a home for the cure of diseases") we have in Pāli *gilānasālā* ("a hall for the sick").[13] Besides *gilānaśālā* we come across another term *sotthi-sālā* as an exceptional term to denote the Indian idea of a hospital.

The real impetus to the building of hospitals and similar institutions was given by king Aśoka who in his Rock Edict II claims to have made arrangements for two kinds of treatments, one suitable for men and the other for animals. He made those

11. *Ibid.*
12. Presidential Address. *Proc. and Trans. 9th All Ind. Orient. Conf., 1937.*
13. *Samyutta*, iv. 210; *Aṇguttara*, iii. 142; *Visuddhimagga*, 251.

arrangements not only throughout his wide dominions but throughout the principalities of his allies as well including the territories of the five Greek rulers in the north-west.

The Kauṭilya *Arthaśāstra* (ii. 4. 55) expressly recommends the construction of *bhaiśajyagṛha* (another term for hospital) at the north-west corner of the compound of a fort. The same *Arthaśāstra* refers even to an organization similar to, if not the same as, the modern Red Cross Society. The passage in question runs thus : physicians with surgical instruments, machines, remedial oils, and bandages in their hands; women in charge of food and beverage, etc.[14] The foundation of hospital, *ārogyaśālā,* is praised in the *Vaidyaka Śāstra*-s as a monumental work of piety. The hospital was to be equipped with the following requistes : 1. a good stock of important drugs; 2. expert physician; and 3. a good store of food and regimen. The following are mentioned as qualities of expert physicians : that they will be well versed in the science, wise and adept in diagnosis and choice and application of drugs as well as in the prescription of proper diet. According to Suśruta the surgical ward *(braṇitāgāra)* is to be equipped with : 1. medicine; 2. necessary articles of diet; 3. dissecting apparatus *(śastra*-s and *aṇuśastra*-s) including splints; 4. aspirator to drain off blood, etc.; and 5. bandages, suture material and surgical box.

Beal[15] records that Silāditya of Kanauj erected *puṇyaśālā*-s in all the high ways of the towns and villages of India. These were provided with food and drink, and physicians were stationed there with medicines for travellers and poor persons of the localities. Fa-Hian describes a hospital which he found in Pāṭaliputra. He says : The nobles and householders of this country have founded hospitals within the city to which the poor of all countries, the destitute, cripples and the diseased may repair. They receive every kind of requisite held gratuitiously. Physicians inspect their diseases, and according to

14. Bk. x. 367; Eng. trans. (1915), p. 443; see also N. Banerji, p. 191.
15. Loc. cit. *Buddhist Records of the Western World,* vol. i. Bk. v. p. 214; also vol. i. Intro., p. lvii. See also Majumdar, *Same aspects of Indian Civilization,* chap. viii (1938).

their cases order them food and drink, medicine or decoctions, every thing in fact that may contribute to their ease. When cured they depart at their convenience.

CONCLUSION

I have given above a very succinct account of the origin and development of the Science of Medicine in Ancient India (pre-Christian age). The account has been scrappy indeed. I am not sorry for it. Those who have read Royle's *Antiquity of Hindu Medicine*, and Ainslie's *Materia Medica of India* are aware that the Arabians were the first to derive their knowledge about medicine and the healing art from the medical works of the Hindus, and the Greeks later on derived this knowledge about medicine from the Arabians. "Dietz proves that the late Greek physicians were acquainted with the medical works of the Hindus and availed themselves of their medicaments; but he more particulary shows that the Arabians were familiar with them and extolled the healing art as practised by the Indians, quite as much as that in use among the Greeks" (Royle, p.64).[16] The other day Dr. Green Armitage of the Calcutta Medical College told his students : "You are being surprised by the study of our surgery, but you do not know that our entire Science of Surgery is based on your *Suśruta-saṃhitā*. Even we have not been able to assimilate the *Saṃhitā* on a variety of subjects. There were surgical instruments sharp enough to split a hair".[17]

But it is a great regret to us that the European writers of the History of Medicine are not willing to give our ancestors the honoured place they should hold in the History of the Science of Medicine. The contribution of the Hindus to this

16. Introduction to vol. I, vii-x, trans. of the Suśruta Saṃhitā by K. L. Bhishagratna; *History of Indian Literature* by Weber; *History of Aryan Medical Science* by Thakore Saheb of Gondal; *Hindu System of Medicine* by Dr. Wise; *History of Indian Medicine* by G. N. Mukhopadhyaya; *Materia Medica of the Hindoos* by U. C. Dutta; and others.
17. *Medical College Journal*, quoted by Mallik. A. B. Patrika, July 1949.

Science has not been acknowledged in the *Encyclopaedia Britannica* in the chapter on Medicine.

III. SCIENCE OF AGRICULTURE

There is evidence supplied by the pre-historic finds discovered in different parts of India by the archaeologists that the Neolithic Indian was primarily an agriculturist and used to live in thatched houses and most probably wore clothes of some sort.[18]

The Iron Age people of India were more advanced; rice, millet, cotton fabrics and other agricultural produce have been found in their burial sites. They were a civilized people, and had maritime intercourse with Egypt and their trade consisted of spices, unguents, ebony and other rich woods amongst others.

But the excavations at Harappa and Mohenjo-Daro[19] (3500 B. C.) have brought out undoubted evidence of brisk agriculture, and that barley, wheat, millet, melon, dates, cotton, fruits and other vegetables were cultivated, and the wealth of these Indus Valley people was derived mainly from agriculture and trade.

BEGINNINGS OF AGRICULTURAL SCIENCE (VEDIC AGE)

When we come to the Vedic period (2000 B. C.—800 B. C.) we find that agriculture has become the universal occupation

18. P. Mitra, *Prehistoric Culture and Races of India*, Jour. Dept. of Letters, 1920. Cal. Univ. Vol. I, p. 143.
Archaeological Survey Report, India, 1902-03, 1908-09; and see Mr. Rea's *Catalogue*; Bissing, *Prehistoriche Topfenaus Indien und Aegypten*, 1911, chap. viii; Brugch's *History of Egypt under the Pharaohs*. *Book of the Dead*, pp. 145-146, where unguents from Punt is mentioned, and on p. 192, spices. Mitra thinks that these unguents were made from *Candana*.
19. Sir J. Marshall, *Mohenjodaro and the Indus Valley Civilization*, Lond., 1931.

of the Vedic Indians. They developed agriculture to an extent which yielded them plenty so that hospitality came to be regarded as a cardinal virtue *(RV.* x. 117)[20] :

"He who possessed of food hardens his heart against the feeble man craving for nourishment, against the sufferer coming to him for help, and pursues (his own enjoyment even) before him, that man finds no consoler." [2]

"The inhospitable man acquires food in vain. I speak the truth, it verily is his death. He cherishes not Aryaman, nor a friend, he who eats alone is nothing but a sinner." [6]

Agriculture needs the cultivator, the soil to be cultivated and the implements with which to cultivate. Evidence of all these we find in the Vedic Texts. Importance of agriculture is stressed in the *Ṛgveda* (x. 34. 13; x. 117. 7). The *ṛṣi*-s regarded agriculture as a holy and dignified occupation *(RV.* iv. 57) :

"May the herbs (of the field) be sweet for us, may the heavens, the waters, the firmament be kind to us, may the Lord of the field be gracious to us, let us undeterred (by foes) have recourse to him." [3]

"May the oxen (draw happily), the men (labour) happily, the plough furrow happily, may the traces bind happily, wield the goad happily." [4].

"May the ploughshares break up our land happily, may the ploughmen go happily with the oxen, may Parjanya (water) the earth with sweet showers happily; grant Suna and Sira prosperity to us." [8]

From another hymn *(RV.* x. 101) it appears that they had recourse to artificial water supply when necessary, and used horses, and the fundamental principles of agriculture were known to them.

"Harness the ploughs, fit on the yokes, now that the womb of earth is ready sow the seed therein, and through our praise may there be abundant food; may (the grain) fall ripe towards the sickle." [3]

"Set up the cattle-troughs, bind the straps to it; let us pour

20. *Ṛgveda*, Eng. translation by Wilson, vols. i, iii iv, vi.

out (the water of) the well which is full of water, fit it to be poured out, and not easily exhausted." [5]

"Satisfy the horses, accomplish the good work (of ploughing), equip a car laden with good fortune, pour out (the water of) the well, having wooden cattle-troughs, having a stone rim, having a receptacle like armour, fit for the drinking of men."[7]

For successful cultivation soil was repeatedly ploughed (*RV.* i. 23. 15), principles of irrigation was understood (x. 99. 4), rotation by fallowing was practised (viii. 91. 5, 6), and to improve the fertility of the soil cow dung manure (*sakṛt*, i.161. 10) was applied. The cattle was well looked after and grazed on good pastures : "grazing upon good pasture and drinking pure water at accessible ponds (vi. 28.7)". Barley was the staple crop grown (i. 117. 21; ii. 14. 11 etc.). The grains were collected, threshed on the threshing floor (x. 48. 7), winnowed with a sieve (x. 71. 2), and finally stored in a granary (ii.14.11). The lands used to be distributed among cultivators by measurement ("measure the land with a rod", *RV.* vol. i. p.56, Wilson, Eng. ed.). Ripe grains in the field were protected against birds : "the husbandman calls out when keeping the birds off the ripe grain" (*RV.* x. 68. 1) and the distribution of the six seasons in the year for practical purposes was known ("Verily he has brought to me, successively the six [seasons]", (i. 23. 15 etc.).

In the *Atharvaveda*[21] the whole process of agriculture appears to be sanctified by a hallow of Divinity. Hymns are recited for successful agriculture (iii. 17). "Scatter the seeds in prepared womb", "harness the plough", etc. We find the same mode of ploughing the land, preparing the womb of earth, broadcasting the seeds, cutting the corn with the same sickle when they are ripe. The hymn iii. 24 is addressed to the god of Plenty so that he might favour the worshippers with abundance of grain. Hymn 15 (Bk. iv. p. 172) conveys a beautiful tribute to Rain which is a vitally necessary agency in the luxurious development of herbs and plants :

21. *Atharvaveda*, all the hymns referred to are from Whitney (1905).

"Let the mighty liberal ones cause to behold together; let the juices of the waters attach themselves to the herbs; let gushes of rain gladden the earth, let herbs of all forms be born here and there;...let the herbs become full of delight with the coming of the rainy season."

Hymn 50 (Bk. vi. p. 317) enumerates the animal enemies of corn[22], and invokes the Divine aid for their destruction; and two more hymns (Bk. vi. 59, p. 325; Bk. iv. 21, p. 187) are devoted to the protection and praise of the cattle.

"Rich in progeny, shining in good pastures, drinking clear water at a good watering place—let not the thief master you, nor the evil plotter; let Rudra's weapon avoid thee."[7]

Manuring as general practice has been mentioned (xix. 31. 3); cow dung *(sakṛt)* was recommended ("rich in manure, rich in fruits", etc., xii. 4. 9); but later on cow dung was found to give better result when dried before application *(karīṣa,* iii. 14. 3-8; xix. 31. 3). This shows that they understood the value of natural manure of animals in the field (cp. Zimmer, *Altindischen Leben,* p. 236). The application of *karīṣa* was also recommended in the *Śatapatha Brāhmaṇa* (ii. 1. 17), and the *Taittirīya Saṃhitā* (vii. 1. 19. 3. etc.).

We have already seen that to improve the fertility of the soil rotation by fallowing was practised during the Ṛgvedic period (*RV.* viii. 91. 5-6), but the *Taittirīya Saṃhitā* (v. 1. 7. 37) recommended "rotation of crops" by showing different crops alternately on the same field, i.e. rice in summer and pulses in winter *(dvi saṃvatsarasya śasyaṃ pacyate)*. The *Yuktikalpataru,* a much later work, gave the following reason why the rotation should be practised :

tathā varṣeṣu varṣeṣu karṣaṇāt bhūguṇakṣaya
ekasyam guṇahīnāyāṃ kṛṣimanyatra kārayet. [41-42]

Rotation of crops was thus known, and to India, Dr. Roxburgh believes, the western world to be indebted for this

22. The *Kauśika-sūtra* of the *Atharvaveda* enumerates the enemies : Ed. Bloomfield. *Jour. Amer. Orient. Soc.* Vol. xiv. 1890. *Khaṇḍika,* 50. 7; 51. 1 -22.

system. Rice, barley, and sesamum were the grains cultivated (vi. 140. 2).

In the *Śatapatha Brāhmaṇa* a detailed description of the agricultural operations, such as, *kṛṣantaḥ, vapantaḥ, lunantaḥ*, and *mṛnantaḥ* (ploughing, sowing, reaping and threshing) are given; manuring for the improvement of the yield was resorted to; irrigation (*khanitra*) done where necessary. Ripe grain was cut with *dātra, sṛṇi* (sickle), bound in bundles (*parṣa*), threshed on granary floor (*khala*), sieved (*titau*), or winnowed (*śūrpa*), the winnowers were called *dhānyakṛt*; the grains were measured in a vessel (*urdara*), and stored in a granary (*dhanadhāni*). The plougland was called *urvarā* or *kṣetra*, manure (*sakṛt, karīṣa*) was used, irrigation (*khanitra*) practised. The plough (*lāṅgala, sira*) was drawn by oxen, teams of six, eight or even twelve being employed.[23]

The cereals cultivated were *yava, vrīhi, upavāka, aṇu, godhūma, nīvāra, priyaṅgu, śyāmāka*, and pulses were *mudga, māṣa* and *masūra*. For oil and food they cultivated *tila*, and vegetables and fruits, such as, *urvārū, urvārūka*, etc. Fruit trees were plentiful, and fruits were plucked ripe (*RV*. iii. 45. 4) either *pakvā śākhā* (*RV*. i. 8. 8), or *vṛkṣapakva* (*RV*. iv. 20. 5; *AV*. xx. 127. 4).

The *Vājasaneyi-saṃhitā* (xviii. 12) mentions *vrīhi, yava, māṣa, tila, mudga, kalāya, priyaṅgu, godhūma, masūra*, etc. as exemples of cultivated grains. The *Bṛhadāraṇyaka Upaniṣad* mentions ten village seeds (*grāmyāni*), namely, *vrīhi, yava, tila, māṣa, aṇu, priyaṅgu, godhūma, masūra, khalva* and *khalakula* (*vetch*).

Seasons of agriculture were also mentioned (*RV*. i. 23. 15). The *Taittiaīya-saṃhitā* records that *yava* is reaped in summer being sown in winter, *vrīhi* in autumn being sown in the beginning of rains; *mudga, māṣa* and *tila* are planted in time in summer rains, ripe in winter and the cool season :

"He gave to the spring (the sap), to the hot season the barley, to the rains plants, to autumn rice, beans, and sesaum to winter and the cool season." (viii. 2. 10. 2.)

23. See *Vedic Index*, vol. i. p. 182. Also p. 183.

Two harvests *(śasya)* a year were gathered *(Taitt. Sam.* v. 1. 73), winter crops in the month of March-April. Excessive rain or drought might damage the crops. The *Atharvaveda* (vi. 50. 142; vii. 11) prescribes spell to prevent the evils which are also enumerated : moles, birds, various kinds of reptiles (*upakvasa, tabhya, tarda*, etc.) injure the young shoots. Definite mention of blight and mildew as diseases of corn and sugarcane we get in the *Vinaya Texts (Cull.* x. 1. 6) during the Buddhist period.

DEVELOPMENT DURING MAURYA PERIOD

By the 4th Century B. C. the art of agriculture received a consummate perfection. It became an important department of the Government, a special officer called the Superintendent of Agriculture, being appointed for the management and supervision of the important industry.[24] This officer was to be a man of accurate and scientific knowledge of the subject, or assisted by those who are trained in such sciences.

The duties of the Superintendent (Sītādhyakṣa) were a very extensive one. He was to "collect the seeds of all kinds of grains, flowers, fruits, vegetables, bulbous-roots, roots, creepers, fibre-producing plants and cotton." He was to see that the cultivation of crown land should suffer on no account and enforce laws governing the proper cultivation of the soil.

"The work of these men (slaves, labourers and prisoners) shall not suffer on account of any want in ploughs (*karṣaṇayantra)* and other necessary instruments or of bullocks. Nor shall there be any delay in procuring to them the assistance of blacksmiths, carpenters, borers *(medaka)*, rope-makers, as well as those who catch snakes, and similar persons. Any loss due to the above persons shall be punished with a fine equal to the loss."

24. *Arthaśāstra* of Kauṭilya, xxiv, 117-18, pp. 138-142. Eng. trans. by Dr. Shama Sastri, and edition, 1923. Original Sanskrit ed. by the same author, Mysore Oriental Library Pub. Sanskrit Series, no. 54, 1919, pp. 115-118.

The meteorological observations conducted in connection with and in the interest of Agriculture over the whole of India seem to be simply marvellous for that age :

"The quantity of rain that falls in the country of *jāṅgala* (in the desert countries) is 16 *droṇa*-s; half as much more in moist countries (*ānūpānām*); as to the countries which are fit for agriculture (*deśavapānām*) : 13½ *droṇa-s* in the country of Aśmakas (the countries of Maharashtra); 23 *droṇa*-s in Avanti and an immense quantity in western countries (Aparāntanām —the countries of Konkana) the borders of the Himalayas, and the other countries where water channels are made use of in agriculture (*kulyavapanam*). They used rain-gauge for the measurement of the rainfall in these countries.

"A forecast of such rainfall can be made by observing the position, motion and pregnancy (*garbhādhāna*) of Bṛhaspati (Jupiter), the rise, set and motion of Venus, and the natural and unnatural aspect of the Sun. From the Sun the sprouting of the seeds can be inferred; from the position of Jupiter the formation of grains (*stambakārita*) can be inferred, and from the movement of Venus rainfall can be inferred. Hence according as the rainfall is more or less, the Superintendent shall sow seeds which require either more or less water." (p. 139.)

The Superintendent was also to see that seeds of crops are properly sown and reared in their proper seasons, in proper fields and under circumstances and conditions favourable to the growth. Thus :

"The Superintendent shall grow wet crops (*kedāra*), winter crops (*haimanta*) or summer crops (*graiṣmaka*) according to the supply of workmen and water.

"Lands that are beaten by foam (*phenaghāṭāḥ*), i.e. banks of rivers, etc. are suitable for growing *valliphala* (pumpkin, gourd and the like); lands that are frequently overflown by water (*parivāhanta*) for long pepper, grapes and sugarcane; the vicinity of wells for vegetables and roots; low grounds (*haraniparyantāḥ*) —moist beds of lakes—for green crops; and marginal furrows between any two rows of crops are suitable for the plantation of fragrant plants, medicinal herbs, *uśīra*, *hira* (?), *beraka*(?),

piṇḍāluka (?) and the like."

Then detailed directions are given as to pre-sowing treatment of seeds to mist and heat *(tuṣārapayanāmuṣnam ca)* for seven nights (vernalization anticipated ?); of sugarcane *(kāṇḍabījānām)*, of bulbous roots *(kanda)*, cotton seeds *(asthibīja)*, and how the "water pits at the roots of trees are to be burnt and manured with the bones and dung of cows on proper occasions." Then elaborate directions are given with regard to the sowing of different kinds of cereals, pulses, safflower, linseed, sesamum and mustard, at proper seasons and time.

Megasthenes[25], a contemporary of the author of the *Arthaśāstra*, pays an eloquent tribute to the abundance of crops in India, to the fertility of the soil, to the absence of famine and the peculiar respect in which agriculture and the agriculturists were held. Even at the time of war the combatants used to leave the agriculturists undisturbed as a matter of duty.

By the time of Manu the duty of looking to the agricultural interest of the country became codified into a law, and a special class of people versed in the knowledge of correct measurements and weights, as also good and bad qualities of the soil, sprang up known as the Vaiśya-s. Thus :

"If the land be injured by the fault of the farmer himself, as if he fails to sow it in due time, he shall be fined ten times as much as the King's share of the crops that might otherwise have been raised." (Code, viii. 243).

"Again a Vaiśya must be skilled in seeds, and in the bad or good qualities of land and the correct modes of measuring and weighing." (Code, ix. 330).

KṚṢI-PARĀŚARA

A very valued treatise called *Kṛṣi-Parāśara*[26] of uncertain date but composed certainly not later than the 5th Century

25. Fragments of *Indika* of Megasthenes, Bonn, 1846 (Dr. E. A. Schwanbeck).
26. The book is being edited by the author. A translation of the Bengali edition of this book has been published by the Rothamstead Expt. Station in the form of a Bulletin.

A.D.,[27] devoted principally to the cultivation of paddy, and secondarily to other things concerning successful agriculture, throw a flood of light upon the perfection attained by the art of Agriculture in ancient India.

It deals with such topics as metereological observations leading to the prediction of scarcity, drought and abundance of rain, superintendence of the fields and its produce; tending of the herd needed for cultivation; preparation and application of manure; the construction of agricultural implements; collection of seeds, sowing, harvesting, etc., etc. This treatise is all comprehensive being full of a large number of pregnant aphorisms relating to the minutest particulars of agricultural processes regarding rules for the transplantation of paddy seedlings, for proper drainage, irrigation of rice fields, etc., etc.

IV. SCIENCE OF ARBORI-HORTICULTURE

The science of Arbori-Horticulture[28] developed in ancient India as a distinct branch of *Vṛkṣāyurveda (vṛkṣāyurvedaphalam,* applied botany) dealing with the construction and maintenance of gardens and public parks. The existence of this science in a rudimentary form can be traced to the Ṛgvedic times. It played an important part in later days in Public Administration. Public parks and pleasure gardens were provided by the Government for health, recreation and enjoyment of the public (Kauṭilya *Arthaśāstra, Śukranīti* and *Kāmandaki-nīti).*

27. Bhaṭṭotpala, the commentator of Varāhamihira's *Bṛhatsaṃhitā* in explaining the prescriptions in the section on Vṛksāyurveda has elucidated the points by certain quotations from three earlier authors, namely, Kāśyapa, Parāśara and Sārasvata. The authorship of the treatise is ascribed to the second author.

28. It is not possible for me to give here a connected story of the genesis and development of the Science in Ancient India. Attempt is being made in this article to give an account of the development of the Science as could be gleaned from the Vedic Texts, Kauṭilya *Arthaśāstra,* Vātsāyana *Kāmasūtra, Bṛhatsaṃhitā, Śukranīti* and the *Upavana-vinoda.* Only the contents of the last have been noted.

All decent houses (Vātsāyana *Kāmasūtra)* and palaces of kings had pleasure gardens attached to them. These were well laid out, kept in perfect order and placed in charge of well trained experts, the Ārāmādhipati-s. In ancient dramas and epics and amatory poems flowers and flower gardens played important parts, and a special class of artists, gardeners and weavers *(mālākara-*s and *mālinī-*s*)* came into being enjoying protection of State *(Śukra*, ii. 83).

The construction of a garden and its dedication to public use is mentioned as early as in the Vedic period *(RV.* iii. 8. 11). Sāṇkhāyana in his *Gṛhya-sūtra* described this Vedic ceremony under "The consecration of a garden" (v. 3. 2 *et seq.*). Though the *Śukranīti* is of a much later date we find that apart from pleasure gardens adjoining a dwelling house, the parks and pleasure gardens used to be regarded as important features of the social life in ancient India. "They were important enough to have given rise to special classes of skilled artisans who were given patronage and protection by the State" *(Śukra*, ii. 83). The artisans used to construct parks, artificial forests and pleasure gardens.[29] The parks were meant for health, recreation, enjoyment, etc., and constituted a spending department of the Government, pure and simple. The gardens and parks were in charge of Superintendents (ii. 200). He was to know the causes of the growth (ii. 317-19) and development of flowers and fruits, the method of planting and curing trees by the administration of proper soil and water at the suitable time, and the various uses of the plants as medicinal drugs. He was assisted by gardeners whose duty it was to collect flowers and fruits after having duly nourished the plants with care (ii. 345-46). The knowledge of grafting was one of the qualifications of the gardener and it came to be regarded as one of the 64 *kalā-*s or arts (iv. iii. 144).

A typical garden attached to a dwelling house is described in the Vātsāyana *Kāmasūtra.*[30] It says : Attached to every house there should be a *vṛkṣavāṭikā* or *puṣpavāṭikā*, a garden with wide

29. *Śukranīti, S.B.H.*, xvi, edited by Sarkar.
30. Chakladar, *Social Life in Ancient India*, G. I. Soc. Series.

grounds where flowering plants and fruit trees can grow, as well as vegetables. A well or tank, large or small, should be excavated in the middle. The garden should be in charge of the mistress of the house. She is to duly procure seeds of common kitchen vegetables and medicinal herbs, such as *mūlaka, trapusa, āluka, pālaṅkī, damanaka, āmrātaka, ervāruka, vārtāka, kuṣmāṇḍa, alāvu, śūraṇa, śukanāsa, svayamgupta, tilaparṇika, agnimantha, laśuna, palāṇḍu* and such others. The direction is also given as to how greens and vegetables are to be reared in specially prepared beds, sugarcane in clumps, stunted shrubs of mustard, *jīraka, ajamoda, śatapuṣpa*, and similar herbs in patches, and the dark Tamala trees in groves. The flowering plants comprise *kubjaka, āmalaka, mallikā, jāti, kuraṇṭaka, navamallikā, ṭagara, nandyāvarta, japa*, etc.; the shrubs include *bālaka, uśīra*, and other grasses which yield fragrant leaves and roots. The garden is also to be provided with bowers and vines groves with raised platforms here and there for rest and recreation. A swing too is to be fitted on a spot well guarded from the Sun by a leafy canopy. The text speaks indeed of an abundance of various flower plants to be artfully arranged, here and there.

The garden within the homestead of Vasantasenā[31] was a paragon of beauty. The flower beds were all artistically laid out and various trees planted, some heavy foliaged with swings hung from their branches. The golden yuthikā, the śephalikā, mallikā, mālatī, the navamallikā, the kuruvaka and mādhavi were the sweet and fragrant flowering plants with their flowers that had lent charm to the garden. The tanks were charmingly adorned with red and white lotuses and lilies. The Aśoka trees with their red flowers in bunches stood up here and there like posted soldiers.

In the Buddhist literature we find description of the pleasure gardens of kings Bimbisāra and Aśoka, as special places of diversion. Such gardens were full of shady and flowery arbors. The Veṇuvana and Āmbavana in the vicinity of Rājagaha, the Mahāvana near Vesālī,the Nigrodhārāma near Kapilavastu

31. *Mṛcchakaṭika*, iv. 28-30, ed. Haridāsa Siddāntavāgīśa, Calcutta.

and the Jetavana in the outskirts of Śrāvastī, were all royal gardens, but later opened to all chance visitors. Queen Mallikā's garden at Śrāvastī was beautifully enclosed on all sides by rows of Tinduka or Timbaru trees. "It was a flower and fruit garden, as well as a park provided with sheds." Subsequently these gardens were converted into permanent retreats for the Wanderers of different Orders.

The Aśokavanīkā[32] which was Rāvaṇa's pleasance, was the best, a graphic description of it is found in the *Rāmāyaṇa (Sund.*, xiv, xv). It was surrounded by a wall. Within the enclosure was a sylvan grove with the Sāla, Aśoka, Bhavya, Campaka, Uddālaka, Nāga and the mango trees, all in blossoms in season. The grove was surrounded by artificial mounds and contained herds of deer and many sweet singing birds. The place was surrounded by many kinds of trees, and the earth appeared beautiful strewn with heaps of fragrant and charming flowers fallen from the trees. Nearby were tanks large and of various other sizes with transparent and sweet water, fitted with bathing ghāṭs having beautifully made steps set with jewels and crystal posts. The bank was artistically lined with columns of trees while the watery portion looked exceptionally beautiful with full blown lotuses and lilies. The tank served as a special retreat for geese, swans, *cakravāka*-s and a host of aquatic birds. The trees on the banks were entwined with hundreds of creepers having flowering Santāna and Karavīra as diversions. Not far from these series of tanks was a hill with beautiful and wonderful peaks. All elevations of this picturesque hill were decked with trees and hilly abodes. A long and beautiful stream of clear and sweet water issuing from this hill flowed through this garden. Its banks were artistically lined with trees with many hanging branches and creepers that touched the water. Besides the hill was a lotus pond gay with many birds. There was also to be seen a big tank full of cool water. Its steps were all jewels being set with stones, and around were many palatial buildings all made as though by

32. *Rāmāyaṇa*, *Sundarakāṇḍa*, 63, 64.

the hands of Viśvakarmā himself. Everywhere were to be seen rows of artificial mounds and flowery groves. The fruit and flower trees had golden and silver pavements and terraces at their bases. A large Śiṃśapā tree with spreading branches and adorned with big foliage and entwined with creepers and fitted with a golden terrace at the base added much charm to the scenary (xiv. 1-52).

At another place this garden is compared with the Nandana-vana, the Celestial Garden, containing various animals and birds, palaces and mansions, adorned with ponds abounding in beautiful lotuses and water lilies, provided with many comfortable seats, sylvan retreats, bowers and arbors with beautiful flowers of all seasons and fruit trees. The Karṇikāra, the Kiṃśuka, the Punnāga, Śaptaparṇa, Campaka and the Aśoka trees were in flowers, and so on (*Sund.* xv).

My object is to show that the art of Arbori-Horticulture attained great perfection in ancient India. We have no treatises extant (so far discovered) on this subject, but we have a small chapter, the *Upavana-vinoda*[33] as a branch of Vṛkṣā-yurveda, in Śārṅgadhara's encyclopaedic work, the *Śāraṅga-dhara-paddhati*, of the 13th century A.D. The author undertook to compile the treatise at the command of his king for the benefit of his subjects.

The chapter, *Upavan-vinoda*, treats of Arbori-Horticulture and discusses the following topics :

1. Glory of trees.
2. Good and evil omens relating to residence near the Trees.
3. Selection of soil (for planting trees).
4. Classification of plants.
5. Sowing of seeds (and Methods of their Propagation).
6. The process of planting.
7. Watering of plants (after planting).
8. The rules of the protection of plants.
9. Construction of a garden house.

33. *Upavana-vinoda*. The text has been edited, translated and published by Majumdar.

10. Examination of the soil where wells (for watering) are to be dug.
11. Rules for the nourishment of plants.
12. Kuṇapa water (recipe for a nutrient solution).
13. Treatment of plants in diseases and health.
14. Botanical marvels (experimental results), and
15. Ascertainments of the prices of things based on certain signs developed in plants.

A clear idea of the contents of the chapter and their historical and scientific importance may be formed from the conspectus given below.[34]

1. *Glory of Trees*

The plants are glorified because of their utility. They are either sacred to some deity or are shade giving, or fruit bearing or bearing flowers which one needed for worship. The custom of planting shady fruit trees along the public throughfares, or constructing gardens and consecrating them for public use has been of immemorial antiquity. Like many a good thing in India it received a religious sanction. The general idea underlying the whole practice is one of public utility; even in the Edicts of Aśoka (Rock Edict II, and Pillar Edict VII) this has been regarded as an act of Piety. And by the time of Manu de truction of plants come to be regarded as State offence, and in his Code provision was made for its punishment (viii. 285, 330, 331; ix. 143, 145).

2. *Good and evil omens relating to residence near trees*

Reference to the trees and plants which are to be avoided in *devālaye tathodyāne gṛheṣūpavaneṣu ca* (in temple yards, gardens, homesteads, and parks, etc.) is plentiful in ancient literature. To promote the hygienic effects of different trees and shrubs it is enjoined that "thorny shrubs should be so planted as to edge the southern boundary of the ground of a house. The flowering garden should be laid out adjoining a dwelling house and

34. For details see Introduction, pp. 1-33 of the *Upavana-vinoda*.

blooming plants and sesame should be cultivated therein." Śukrācārya is more pratical on the subject. His general instructions on the point are : one should lay out a fair garden to the left of the dwelling house (IV. iv. 104); he should plant those trees which bear good fruits very near the village (IV. iv. 103). Then he gives a long list of such *phalinaḥ* (fruit bearing) trees in IV. iv, 95-102. His other general instructions are to plant thorny trees in forests (113-114) and expansive trees, shrubs and creepers "in village if domestic, and in forests, if wild" (123-124).

3. *Selection of soil*

The texts show that classification of soil was based on two grounds—medicinal and economic. The medical authorities, like Caraka and Suśruta, had in view the efficacy of vegetable drugs which depend on the nature of soil in which they grow. And politicians like Kauṭilya cared for the productivity of different types of soil, an attention to which is necessary on the part of a good government to prevent famine, etc.

4. *Classification of Plants*

A broad classification of plants into trees, shrubs, creepers and herbs became necessary to indicate the type of plants to be planted in different kinds of soil, and for different purposes.

5. *Sowing of seeds*

Elaborate prescriptions are given in the *Arthaśāstra* and other ancient treatises for the pre-treatment of seeds before sowing, even vernalisation seems to be anticipated by the authors of *Arthaśāstra* and *Bṛhatsaṃhitā.*

In this connection various methods of propagation, such as, by seeds, by roots, by cutting, by grafting, by apical portions, by leaves and by saunarudhaja (?) are mentioned in the ancient texts. They were reared from different sources and by different methods in beds under great care by experts well versed in the operations.

6. *The process of plantation*

The process of plantation received attention for the first time in the *Arthaśāstra* (xxiv. 115). The Superintendents of parks and gardens, according to *Śukranīti*, were to know "the cause of growth and development of flowers and fruits, the methods of planting, and curing the trees by administering proper soil and water at the suitable time", etc. (ii. 317-319).

Varāhamihira (author of *Bṛhatsaṃhitā*) prescribes that in months of Māgha and Phālguna (*śiśire*) are to be planted the trees whose branches and leaves are not developed, in the months of Agrahāyaṇa and Pauṣa (*hemante*) the plants with just developed branches and in the months Śrāvaṇa and Bhādra (*varṣāgame*) plants with well developed branches [6]. Kāśyapa, an older authority, is more clear on the above directions. He says : Plant in *śiśira* those trees that are with undeveloped branches, and in *hemanta* those with developed branches according to prescribed rules (*vidhānataḥ*), and those that are provided with well developed branches during the rains.

Varāhamihira then gives elaborate directions for treatment of plants before transplanting them, and finally he directs that it is best to transplant trees at intervals of 20 cubits, next at 16, and 12 cubits' interval is the minimum that can be prescribed [12]. And why this minimum ? Otherwise the roots will become mingled together, will interfere with each other's function, and will become ill at work, and fruits will not be produced [13].

7. *The rules for watering of plants (after planting)*

In the *Bṛhatsaṃhitā* the following prescription is given : After the trees are planted one should water them in the morning and evening in summer, at the end of the day in winter, and during the rainy season only when the earth is dried. But Śukrācārya gives a variant prescription. He says : "The trees are to be watered in the morning and evening in summer, every alternate day in winter, in the filth part of the day (i. e. afternoon) in spring, and never in the rainy season."

9. *Construction of a garden house*

In the introductory portion of this article reference has already been made to this subject.

10. *Examination of the soil where wells are to be dug*

An elaborate chapter in the *Bṛhatsaṃhitā* (chap. liii) has been devoted to this topic.[35] On an analysis of the whole chapter we find elaborate directions are given as to : 1. the selection of the soil for digging or boring a well (artesian or otherwise) in a waterless tract; 2. the ways and means of such digging or boring and construction of special apparatus for the purpose; 3. directions as to the erection of dam with flood gates for storing water, and finally, 4, recipes for clearing, disinfecting and purifying and even perfuming the water for human consumption.

The art of ascertaining the presence of water through its vegetable accessories and digging artesian wells reached a great perfection in ancient India (see *Jataka Story*, Fausboel *Vannupatha Jataka*, vol. I, Combridge ed., 1895).

11 & 12. *Rules for the nourishment of plants and Kupana water :*

The origin of manuring the soil, a necessity for the nourishment of plants, can be traced, as we have already seen, as early as to a verse in the *Atharvaveda* (ii, 8. 3). But a more elaborate instruction in manuring is given in the *Bṛhatsaṃhitā* (chap. 58), the *Sukranīti* (iv. 4. 107-112), and the *Kṛṣi-Parāśara* (*śloka*-s 107-109). From all these prescriptions Dr. Seal[36] concludes : "These elaborate recipes are empirical contrivances for supplying the plant with the requisite nitrogen compounds, phosphates, etc., these being potentially contained in the mixtures and infusions prescribed."

35. *Bṛhatsaṃhitā*, 2 vols., The Vizianagram Sanskrit Series, vol.10, Benares, 1895-97. Trans. *Verspreide Geschriften*, vol. 2, pp. 27-37, by Prof. H. Kern, 1913.

36. Seal, *Positive Sciences of the Ancient Hindus*, London, 1915

8 & 13. *Rules for the protection and treatment of plants*

Destruction of plants by pestiferous insects and fungi are referred to in ancient literature. A hymn in the *Atharvaveda* (vi. 50) refers to the destruction of corns by animal agencies. The *Vinaya Piṭaka* mentions (*Cū.* x. 1. 6) blight and mildew as cereal diseases. But in the *Arthaśāstra* (chap. xxiv), and *Bṛhatsaṃhitā* (chap. liv) we find distinct sections devoted to the treatment of plants in health and diseases (see Majumdar, *Vanaspati*). Varāhamihira, the author of the *Bṛhatsaṃhitā*, gives the etiology and diagnosis of the diseased condition of a plant (*etaiścinhaistaru sarogojñeya*). He then prescribes remedies even for the cure of barrenness. As one of the remedies, removal of affected parts with a knife has been suggested (*śastrenādau hi śodhanam*), and the application of mud kneaded with ghee and *viḍaṅga* to the wound is recommended.

14. *Botanical Marvels*

Varāhamihira gives us a few recipes by the application of which some botanical wonders may be produced (chap. liv).

Like other branches of art or science in ancient India Arbori-Horticulture had developed under the patronage of kings and aristocracy. Marvels or extraordinary results achieved by the specialists and experts from time to time in different branches, as the ancient records clearly indicate, did not pass unnoticed or unrewarded. The Uddānapāla-s or the experts under whose charge the royal gardens were placed had ample opportunities of making their experiments, and incentive to producing marvellous results was, of course, the expectation of recognition and reward. There is one Birth Story, the *Dadhivahana Jātaka*, which records the interesting instance of a two-fold marvel : (1) of bringing in conditions by which a mango tree bearing wonderfully sweet fruits began to bear fruits with bitter taste, and (2) of restoring the former sweetness of the fruits. The same story further mentions "the early blossoming of trees out of season (*akālapupphāni pupphapento*) and the early bearing of fruits out of season" (*akālaphalāni ganhapento*) as two among the accomplishments of the expert. In the same connec-

tion we learn that the improvement of a species or a variety depends primarily on the selection of seeds, the soil and the condition under which plants grow.

15. *Ascertainment of the prices of things*

A chapter (ch. xxix) in the *Bṛhatsaṃhitā* is devoted towards the subject. The things include the commodities, crops, general well-being and even signs of coming rains or impending droughts can be predicted through observations of the growth of leaves, flowers and fruits of trees, i.e. plants.